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THE AIR FORCE IN SPACE

FISCAL YEAR 1965

by

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FOREWORD

The Air Force in Space, Fiscal Year 1965, is the eighth in a series of historical monographs that covers Air Force involvement in space activities during the 20 years since 1945. This monograph deals primarily with Headquarters USAF relations with the Office of Secretary of Defense, the National Space and Aeronautics (NASA), the Joint Chiefs of Staff and the concerned joint and air commands in formulating policy and planning for the Titan III, communication satellite, space detection and tracking, antisatellite system, and other programs. The Air Force space program is also examined in reference to the national space program, as is its supporting role in NASA's wide-ranging activities.

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I. THE AIR FORCE AND THE NATIONAL SPACE PROGRAM

The Air Force Role in Space

(U) The Air Force role in space was circumscribed by a long-standing national policy that the National Aeronautics and Space Administration (NASA) should be primarily responsible for exploration and peaceful uses of space. Nevertheless, the Air Force conducted an impressive space program in fiscal year 1965 that involved about $1.474 billion or 20 percent of the Department of Defense (DOD) research budget. There could be no question, as Secretary of Defense Robert S. McNamara told the House Subcommittee on Appropriations in March 1965, about the usefulness of the many unmanned military space systems in operation, including weather, observation, communication, geodesy, and navigation.[1]

(U) Frequently, however, as the Secretary also pointed out, the value of these military systems and their applications was obscured by the uncertainty about the usefulness of military man in space. This was an emotionally charged question reminiscent of the days of Billy Mitchell and other early airpower advocates. And while airmen and their supporters from the aerospace industry frequently chafed about the restrictions that the Office of the Secretary of Defense (OSD) placed on Air Force participation in manned space exploration because there was no clearly defined manned military space mission, neither could Air Force leaders spell one out with certainty. Secretary of the Air Force Eugene M. Zuckert had to admit to the same committee, "Quite frankly, we do not know what man will do in space. We believe that just as has always happened in the past...man will prove there are things he can do which will further our military capability."[2]

(U) Dr. Albert C. Hall, Deputy Director of Defense Research and Engineering (DDR&E) for space, saw the issue in terms of money. During a 3 March 1965 briefing to industry, he declared that balanced against the cost "we have not yet proven that /man's/ unique capabilities of judgment and discrimination should be exercised in orbit." Thus, from the standpoint of cost and man's usefulness, "should man exert his capabilities directly or remotely?"[3]

(U) Dr. Hall was not the first DOD official to pose this question. Secretary McNamara had studied it for months before deciding on a number of steps in December 1963 designed to find some of the answers. At that time, he had initiated a series of actions which called for discontinuance of Dyna-Soar, expansion of ASSET in its place, and development of a manned orbital laboratory (MOL) to define the usefulness of military man in space.*

The Air Force and the National Ranges

(U) During the year the Air Force took final implementing actions on Secretary McNamara's decision of 16 November 1963 to consolidate most of the missile and space test ranges under USAF management. On 1 July 1964 the Navy transferred its Naval Missile Facility, Point Arguello, Calif., to the Air Force, and it was incorporated into Vandenberg AFB. In January 1965 the newly established Air Force Western Test Range (AFWTR) completed final preparations for operating the range and, on 1 February, formally assumed management from the Pacific Missile Range.[4]

* See Gerald T. Cantwell, The Air Force in Space, Fiscal Year 1964 (S-Gp 4), (AFCHO, 1967), p 28 (hereafter referred to as Cantwell). ASSET is discussed below in Chapter VII. The MOL program, for reasons explained in this reference, continues to be covered elsewhere.

[redacted] About the same time, OSD approved a proposal for fiscal year 1965 and 1966 funding levels of $3.3 and $52.3 million, respectively. This permitted the Air Force to expedite the expansion of communications down range, since this capability had not been transferred from the Navy.[5] Other important changes included establishment of a new communication center at Wheeler AFB, Hawaii, and the transfer to NASA of the Canton Island facilities on 1 May 1965 and of the Kokee Park, Hawaii, tracking station on 1 June.[6]

[redacted] Meanwhile, in December 1964 OSD approved 325 additional civilian spaces to accommodate the consolidation of supply activities at the Air Force Eastern Test Range (AFETR).* During the year the Air Staff and Dr. Alexander H. Flax, Assistant Secretary of the Air Force for Research and Development, looked at AFETR's future with some concern. An obvious shift of missile launchings from AFETR to AFWTR was taking place as the intercontinental ballistic missles (ICBM's) completed their developmental cycles, and this was reflected in a decision on 9 December 1964 to reduce 1966 RTD&E funds for the range from $205.6 to $189.1 million.[7]

Organization of the Satellite Control Facility

[redacted] At the end of fiscal year 1964, there was still one major difficulty in complying with Secretary McNamara's direction to consolidate range management. This involved the 6594th Aerospace Test Wing's Satellite Control Facility (SCF) at Sunnyvale, Calif. which provided the on-orbit support for DOD space programs,

* For more detail on this subject, see p23 below.

[redacted] On 5 June 1964 Under Secretary of the Air Force Brockway McMillan had disapproved an Air Force Systems Command (AFSC) proposal to place the facility under the newly created National Range Division, with the latter responsible for all management, planning, and operations. Dr. McMillan wished to consolidate all support for the Office of Special Projects in one organization, preferably AFSC's Space Systems Division (SSD).

[redacted] On 16 June AFSC briefed the Under Secretary on four alternate proposals, one of which allowed for alignment of the SCF directly under SSD. With some slight adjustment, this concept satisfied Dr. McMillan's requirements. Consequently, on 14 August he informed the Air Staff and DDR&E that he had decided to strengthen the position of the SCF by combining the test wing and SSD's Deputy for Space Test Operations in one office at SSD under a general officer. He also intended that the consolidated unit be called the Air Force Satellite Control Range, but Lt. Gen. James Ferguson, Deputy Chief of Staff, Research and Development, and Gen. John P. McConnell, Vice Chief of Staff, dissuaded him and the Air Force Satellite Control Facility designation stood.[9]

The National Space Launch Vehicle Review

(U) Near the end of fiscal year 1964 the Air Force had analyzed current and future launch vehicle combinations and requirements for the 1966-71 period. Completed on 2 July 1964, the Air Force study generally concluded that with a few exceptions no financial gain would accrue from either reducing the numbers of different launch vehicles in the national inventory or from substituting vehicles in existing programs. These conclusions were soon validated by a broader national review.[10]

(U) By this time, in consequence of Mr. McNamara's decision to phase some of the ICBM's from the force, he and NASA Administrator James E. Webb had agreed that a joint study of NASA and DOD space boosters and payloads should be conducted by the Launch Vehicle Panel of the Aeronautics and Astronautics Coordinating Board (AACB). On 19 June the panel was instructed to study alternatives by which those launch vehicles in existence or under development could best and most economically meet existing and projected requirements for the 1965-75 period.[11]

[redacted] As defined by Dr. Harold Brown, DDR&E, and Dr. Robert C. Seamans, NASA Associate Administrator, the study was to match three optional combinations of boosters against all known requirements. Option I was the existing family of boosters less Scout and Saturn V, neither of which had much versatility. Option II excluded Titan III, and Option III included the Titans to the exclusion of all Atlas combinations and Saturn Ib.* For each option the panel considered annual DOD and NASA requirements, production costs, and launch costs, as well as those missions that could not be handled because of performance limitations or time availability. The cost analysis of the alternatives was extensive and time consuming, and the study was not completed until 30 December 1964.

(U) The final report, reviewed by the AACB and many Air Staff officials and endorsed by both NASA and DOD contained a listing of requirements. the launch vehicles to meet them, cost figures, and reliability data. The panel concluded that there was no decisive difference in total costs among the three vehicle groupings. However, it also believed that another option from which

* Thus, Option I contained Thor, Thor-Agena, Thor-Delta, Atlas, Atlas-Agena, Atlas-Centaur, Titan II, Titan IIIA, Titan IIIC, and Saturn Ib; Option II, Thor combinations, Atlas combinations, and Saturn Ib; and Option III, Thor combinations, Titan II, and the Titan III combinations.

financial savings might be realized was possible by judicious mixing of the heavier Titan III and Saturn vehicles. Nothing would be gained by discontinuing any of the individual families of vehicles, i.e., Atlas, Titan, or Saturn, as set forth in the second and third options.[12]

(U) The panel observed that the process of choosing an optimum national family of launch vehicles, or a lower cost launch vehicle for a particular program, could not be treated in isolation; there were extensive constraints which limited the freedom to change vehicle assignments. In general, with the probable exception of Titan III, each vehicle had evolved in response to a particular need. If mission requirements were fixed, as the study assumed, any change of launch vehicle from that initially intended by the user would usually increase program costs. Regulating the character and size of the launch vehicle inventory could only be done realistically in the context of the booster's relationship to other program factors. The interaction among mission definition, payload, design, and launch vehicle development was a process extending over periods as long as five years. While there could be improvement in the long term, the panel believed that these influences severely restricted improvement in the near term.

(U) In general, as Dr. Flax informed the Senate Committee on Aeronautical and Space Sciences, which reviewed the subject of national launch vehicles in late January 1965, the study had shown that no drastic revisions to the national launch vehicle family were required to meet the missions projected for the near future and that no drastic revisions could be justified purely on economic grounds. He also observed that extensive effort by DOD and NASA to improve launch vehicle reliability had paid off, and the two agencies expected this trend to continue.[13]

II. AIR FORCE AND NASA COOPERATION

(U) During fiscal year 1965, as in each of the years since creation of the civilian space agency, the Air Force was deeply involved with NASA in the conduct of the nation's space affairs.

Air Force Participation in the Gemini Project

(U) Gemini was a major part of the U.S. space effort under NASA. Its major objective was to determine the performance capability of a two-man crew in orbit for periods up to 14 days. Other important objectives included orbital rendezvous, docking, maneuver, and controlled reentry. NASA had the sole authority and responsibility to conduct Gemini; DOD assisted the space agency by providing talent, resources, and facilities. Prior to fiscal year 1965 one Gemini flight, the unmanned GT-1, had taken place on 8 April 1964.

(U) The Air Force as DOD agent participated in Gemini in three ways. It provided the direct support operations for the space flights during countdown, liftoff, flight, reentry, and recovery; it pursued some of its own man-in-space goals through on-board experiments; and it converted the Titan II ICBM into a man-rated space booster.

Gemini Support Operations

(U) On 8 September 1964 the Secretary of Defense revised earlier arrangements and designated the commander of the newly created National Range Division as the Department of Defense Manager for Manned Space Flight Support Operations. Previously the commander of the Atlantic Missile Range had held this position. The DOD manager, Lt. Gen. Leighton I. Davis, named the commander of the Air Force Eastern Test Range, Maj. Gen. Vincent G. Huston, as his deputy for Gemini support operations.[1]

(U) The DOD manager's overall support role included four major missions: launch, network, recovery, and bioastronautics. Under the first, he prepared, checked out, and launched the Gemini vehicle and the Atlas-Agena rendezvous vehicle so that they could be inserted into the proper orbits and arranged for acquisition of data to determine vehicle performance. He also provided a network for communication with and observation of the performance of the spacecraft and its occupants and recovered the spacecraft and its crew upon their return from orbit. Finally, he provided NASA with medical people, equipment, and facilities required during preflight preparation, inflight monitoring, recovery, and postflight debriefing and evaluation.[2]

(U) In carrying out his responsibilities, the DOD manager exercised operational control, beginning at T minus 24 hours, of those DOD forces, assets, and facilities committed to support Gemini. The composition of his force included people and resources from most major air and unified commands.

(U) During fiscal year 1965, there were one unmanned and two manned Gemini flights. An indication of the extent of DOD support can be gained from the recovery force deployed as depicted below.[3]

DOD Recovery Support of Gemini Operations in FY 65

Mission	Launch Date	Reentry Date	Crew	Mission Duration	DOD Recovery Resources Men	Aircraft	Ships
GT-2	19 Jan	19 Jan 65	Unmanned	:18	6,562	67	16
GT-3	23 Mar	23 Mar 65	Grissom Young	4:52	10,185	126	27
GT-4	3 Jun	7 Jun 65	McDivitt White	97:56	10,249	134	26

DOD Gemini Experiments Program

(U) The Webb-McNamara agreement of January 1963 on manned space programs had stipulated, among other things, that the Air Force could conduct a series of experiments on NASA's Gemini flights. By the end of fiscal year 1965, the final DOD Gemini Experiments Program consisted of 12 Air Force and 3 Navy experiments, and NASA had scheduled them as follows:[4]

Number	Title	Mission	Date
D-1	Visual Definition of Objects in Space	GT-5&6	9 Aug, 25 Oct 65
D-2	Target Inspection Modes	" "	" "
D-3	Mass Determination	GT-6	25 Oct 65
D-4	Passive Infrared	GT-5	9 Aug 65
D-5	Autonomous Navigation	GT-7&10	10Jun66, 29Jul66
D-6	Visual Definition of Terrestrial Features	GT-5	9 Aug 65
D-7	Observation of Launches	GT-5&7	9Aug65, 10Jun66
D-8	Radiation Measurements	GT-4&6	3Jun65, 25Oct65
D-9	Autonomous Navigation	GT-4&7	3Jun65, 10Jun66
D-10	Autonomous Navigation	GT-10&12	29Jul66, 2Dec66
D-12	Astronaut Maneuvering Unit	GT-9&12	27May66, 2Dec66
D-16	Astronaut Extravehicular Unit	GT-8&12	24Mar66, 2Dec66
N-1(D-13)	Astronaut Visibility	GT-5&7	9Aug65, 10Jun66
N-3(D-14)	UHF, VHF Polarization Measurement	GT-8&9	24Mar66, 27May66
N-10(D-15)	Low-light Level Television	GT-8&12	24Mar66, 2Dec 66

(U) The first DOD Gemini experiments were flown on the GT-4 mission of 3-7 June. These were D-8, Radiation Measurements, and D-9, Simple Navigation, and both were successful. The D-8 experiments measured the specific dose and the dose rate of radiation inside the spacecraft. The resultant data indicated that existing computer codes for radiation prediction inside the spacecraft were inaccurate. Updating them with D-8 information was expected to result in more accurate predictions. Based on these findings, instrumentation for analysis of ionizing power, penetrating power, and dose variation with time and spacecraft location was also developed, flight tested, and made available for future spacecraft applications.[5]

(U) The D-9 navigation experiment proved that use of a USAF-developed sextant in an autonomous navigation system was feasible. The accuracy of the spacecraft position as computed from sextant data was approximately the same as that obtained from ground tracking data. The test also demonstrated that the sextant had a promising capability for making angular measurements associated with spacecraft rendezvous.

Gemini Launch Vehicle Development

[redacted] The development plan of 7 August 1963 had described three general areas of Air Force funded development and testing necessary to adapt the Titan II ICBM as the Gemini Launch Vehicle (GLV). These were longitudinal oscillation, second-stage combustion stability, and general engine performance. Solution of the longitudinal oscillation problem had been demonstrated to the satisfaction of NASA and the Air Force during the launch of GT-1 on 8 April 1964.[6]

(U) On 6 April 1964 Secretary McMillan had approved plans for the Gemini Stability Improvement Program (GEMSIP) and later there were some minor changes to it. By the fall of 1964, AFSC had indicated that it would probably reduce the scope of the Augmented Engine Improvement Program (AEIP). On the basis of these changes, the Air Staff early in December asked the AFSC for a new technical development plan.[7]

[redacted]FSC submitted the plan on 15 December, updating and consolidating schedules, costs, and program details of the several GLV development efforts. Thus, it incorporated the plans for the completed longitudinal oscillation, AEIP, and GEMSIP, superseding all other planning documents in those areas. Some of this work, of course, had already begun on the basis of individual approvals.[8]

(U) Progress on the combustion stability and engine performance problems was good during the final half of 1965. Thrust chamber testing was accomplished between 28 February and 21 April 1965, and engine demonstration testing between 12 March and 22 May 1965. These consisted of 40 tests with the AEIP engines and six with development engines to verify stability under conditions of severe shock. Final selection of the ultimate technical solution to the problem was made on 15 February 1965. In April 1965 the decision was made to incorporate the solution--a new injector--into the Titan boosters for the last five Gemini flights.[9]

(U) By 10 March 1965, sufficient confidence existed in the engine improvement that the Air Force concluded it was unnecessary to flight test the engine changes resulting from the AEIP. Instead, single flight tests of the combined AEIP and GEMSIP products would be made on Titan III R&D vehicles early in fiscal year 1966. As a consequence of this decision, the GLV program was estimated to cost $26.485 million--$11.13 million for AEIP, $3.3 million for the oscillation problem, $11.3 million for GEMSIP, and $.755 million for Titan III flight tests.[10]

Air Force-NASA Personnel Agreements

(U) Under the terms of the NASA-DOD agreement of 13 April 1959, the Air Force had continually loaned a sizable number of people to NASA. On 1 April 1964, Dr. Hugh L. Dryden, the NASA deputy administrator, sought an additional 55, causing Secretary Zuckert to re-examine the subject. At that time, there were approximately 65 Air Force officers on duty with NASA plus a number of AFROTC officers assigned there to complete their service obligations. To that time, 34 officers had completed tours with NASA, of whom 18 were reassigned within the Air Force, 10 retired, and 6

resigned. Eight of the 16 who retired or resigned went to work for NASA as civilians. In addition, about 50 percent of the 45 AFROTC officers who had completed their service commitment with NASA also now worked there in a civilian capacity.[11]

(U) On 5 May Mr. Zuckert invited NASA to participate in the review and emphasized some points he felt ought to form the rationale for future assignments. As a paramount consideration, these Air Force officers comprised a valuable and limited national resource. They could not be "spared" in the normal sense but must be shared with NASA in the national interest. Their temporary loss had to be balanced by the assistance they gave NASA and the value of this experience once they returned to the Air Force. Since only a limited number could be assigned to NASA, Mr. Zuckert thought that they should be placed in key and middle management positions, where they could contribute to the NASA mission while stimulating their own professional growth. Accordingly, the Air Force should assign experienced officers of exceptional ability who had a number of years remaining on their service careers and had indicated an intent to return to the Air Force.

(U) Mr. Zuckert felt that the first step in the review was to establish criteria to determine if an Air Force officer should fill a particular NASA position. Then, all these positions should be screened against these criteria. Thereafter, the Air Force would plan to fill each approved position on a continuing basis. The criteria would also apply to future positions that NASA might establish. The secretary also proposed that the review group consider assignment of NASA personnel to Air Force space programs, as a way of insuring that the Air Force benefitted from NASA's rising level of experience.[12]

(U) Dr. Dryden agreed with the proposal but requested that the review group give priority to the 55 pending positions. These were marked for the Gemini and Apollo programs at Washington, Houston, Huntsville, and Cape Kennedy.[13]

(U) The review group, co-chaired by Maj. Gen. Samuel C. Phillips, a NASA designee, and Col. Lee V. Gossick, a general officer nominee, met for the first time on 15 May 1964 and quickly identified 12 key positions from the NASA request to be immediately filled. The group withheld action on the others until the desired criteria were developed for evaluation of all positions[14*]

(U) The review group completed its work early in August. Secretary Zuckert accepted its report and, on 15 September 1964, signed the accompanying memorandum of understanding, already approved by Dr. Dryden on 17 August, which supplemented the basic DOD-NASA agreement and set forth the criteria for validating NASA and Air Force positions to be filled by each other. Under the agreement, NASA would request Air Force officers only for those positions requiring the education, experience, or skills especially developed by the Air Force in the fields of technical program management, engineering, and physical or life sciences. Any exception would have to be specifically justified. NASA also agreed to make reasonable effort to fill these positions initially through Civil Service channels. Specific name requests were restricted to colonels and generals only. Also discontinued as a general policy was the assignment of AFROTC officers to NASA.[15]

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* The Air Force accepted the group's decision and quickly assigned officers to the 12 positions. Eventually, 42 of the 55 positions listed by Dr. Dryden met the criteria and were filled.

(U) In January 1965 there were, exclusive of AFROTC officers completing their tours, 120 USAF officers assigned to NASA, the majority working with manned space programs:

	MG	BG	Col	LC	Maj	Capt	Lt	Total
Manned Space Flight	1	1	7	15	37	21	7	89
Space Science Applications				1	1		2	4
Advanced Research & Tech				4	1	1	20	26
Others (Wash., D.C.)			1					1
Total	1	1	8	20	39	22	29	120

Shortly after the end of the fiscal year, this total more than doubled when Secretary Zuckert on 16 July 1965 approved NASA's request of May for an additional 128 officers. These were obtained from Atlas and Titan ICBM units being phased out of the operational inventory.[16]

Establishment of NASA Delta Operations at Vandenberg AFB

(U) At the end of fiscal year 1964, NASA was attempting to arrange a Delta launch capability for itself at Vandenberg AFB, Calif., because Delta could not handle all of its foreseen missions from Cape Kennedy.* NASA's proposal of 10 June 1964 called for sole use of the pad as well as launching responsibility for any military satellites employing the Delta. Both aspects of the proposal, particularly the latter, disturbed Air Force officials who felt strongly that these were infringements upon their province of authority. Since the negotiations were incomplete at the time, Secretary Flax had asked DDR&E to allow the Air Force to comment before any formal DOD-NASA arrangements were concluded.[17]

* Delta was a Thor-boosted three-stage vehicle used by NASA to launch Tiros, Echo, Explorer, and other satellites. It was also under consideration for certain military payloads.

(U) Although Dr. Brown gave the Air Force the opportunity to comment on a proposed agreement, its objections were generally ignored, and the memorandum of agreement signed by Dr. Seamans on 14 December and Dr. Eugene G. Fubini, Deputy DDR&E, on the 28th, for the most part gave NASA what it had sought at Vandenberg.[18]

(U) NASA would develop an improved Delta for use on both the AFETR and AFWTR. When the Delta demonstrated reliable performance on the western range, DOD would phase out Thor-Ablestar operations and substitute Delta for military payloads within its capabilities. The Air Force would procure the Thor first stage and chair the joint configuration control board. NASA would procure the Delta upper stage and chair the joint configuration control board for it. NASA would adapt the Delta vehicle to satisfy all requirements and integrate the payload with the launch vehicle.[19]

(U) Each agency would be responsible for direction of its own mission operations. Launch pad and blockhouse 75-1-1 would be used for Delta launches on a shared basis and be scheduled through the Joint Standard Utilization Committee. To minimize interference with Delta launchings, the Air Force would attempt to schedule its Thor-Agena launches from other facilities. DOD and NASA would share the cost of establishing the Delta capability at Vandenberg AFB, based on the estimated usage of the vehicle by each agency. The existing Thor-Ablestar installation would be adapted for use by Delta. In the interest of economy, the Air Force would contract for all Thor booster services, NASA for Delta stage services, and each agency would reimburse the other for the contractor-supplied services that it used.

(U) NASA would exercise launch vehicle control over all Delta launches from Vandenberg, including technical responsibility for and supervision of the

contractor in assembly, checkout, and launch of the vehicle. DOD reserved the right to renegotiate the matter of launch vehicle control for military missions when security considerations or a planned increase in DOD use appeared to make the change desirable. The Goddard Space Flight Center and SSD were designated to prepare detailed plans and procedures. SSD became obdurate on certain points, however, and the negotiations made no progress until June when General Ferguson rather firmly directed AFSC to settle the matter.[20]

DOD Reimbursement Policy on Air Force Support to NASA

(U) OSD policy on support of NASA had been spelled out by DOD Directive 5030.18, 24 February 1962. It had authorized defense agencies to make resources available to NASA so the nation's total assets could be efficiently employed to achieve common civilian and military space objectives. The directive made the Air Force responsible to furnish the bulk of DOD support. Its experience in supporting Project Mercury, plus the realization that NASA would become increasingly active on both the Air Force Eastern Test Range and the Air Force Western Test Range, led the Air Force on 24 December 1963 to revise the rationale of its support of the space agency. The Chief of Staff indicated to AFSC and other affected commands that, contrary to the 1962 OSD directive, their support for NASA should be on a reimbursable basis whenever possible.[21]

(U) During 1964 AFSC conducted a sweeping internal review of its procedures and by mid-March 1965 there was more agreement within the Defense Department on reimbursement. Therefore, on 15 March, Gen. Bernard A. Schriever, AFSC Commander, informed Dr. Seamans that AFSC intended to provide its support services to NASA on a generally reimbursable basis.

He explained that his subordinate commanders had been instructed to re-examine their support relationships and pointed out that the Air Force was now distinguishing between range and base support services.[22]

(U) Dr. Seamans designated a representative to work with AFSC in developing data from which specific reimbursable support might be determined. An initial meeting on 28 April 1965 was devoted to the broad aspects of the subject. AFSC indicated that it was not pressing for across-the-board prorata cost sharing, but rather agreement on such specific items as direct labor, travel, flying hours of aircraft in support, film exposed for NASA, and range costs which were sizable and due solely to NASA.[23]

(U) On 21 May AFSC provided NASA with a draft statement of "reimbursement principles" for support agreements. It stipulated that fully detailed reimbursement clauses would be incorporated into USAF-NASA agreements, explicitly covering unique costs and other support expenses identifiable and measurable in terms of quantities of service provided. The principles then listed approximately 20 specific support functions to be included in all agreements.[24]

(U) After these principles had been discussed in detail at a second meeting, on 24 May, the NASA representative indicated a desire to have the paper reviewed in his headquarters. On 11 June several NASA officials discussed specific points with the AFSC spokesman and, although difficulties would later arise, at that point his list seemed acceptable to NASA.[25]

NASA Support Agreement at Vandenberg AFB

(U) Before it could establish satisfactory support arrangements with NASA at Vandenberg AFB, the Air Force had to first resolve an in-house jurisdictional dispute. Vandenberg AFB was a Strategic Air Command (SAC) base. AFSC, through the AFWTR and other units, was both a major base tenant and the range operator, and SAC was at once host to the range and one of its largest users. This complicated the problem of servicing NASA on the base. As a range user, NASA would normally deal with AFSC as range operator, but as a tenant on the base it would look to SAC as base operator for support, and it resented dealing with two Air Force contacts at the same location.[26]

(U) In a proposed agreement of 20 October 1964, SAC had offered NASA base support generally on a non-reimbursable basis. This, while in keeping with the intent of the OSD directive, generally conflicted with the Chief of Staff's guidance of December 1963 and contradicted AFSC's attempts to obtain reimbursement for these services. SAC thinking was that if presented with the ultimatum that it must pay for this support, NASA might decline it and establish its own base support function. Resolution of the dispute fell to the Air Staff.[27]

(U) Headquarters USAF on 18 February 1965 promulgated policy guidelines. Maj. Gen. William K. Martin, Assistant Vice Chief of Staff, announced that the Air Force would obtain reimbursement on all identifiable NASA requirements for base support. AFWTR would negotiate a basic agreement for support of NASA range user requirements that would also include a host-tenant (SAC-NASA) annex for reimbursable base support. General Martin directed AFSC and SAC to draft jointly the basic agreement and annex and obtain Air Staff coordination before initiating negotiations with NASA.[28]

(U) In the process of preparing its policy for Vandenberg AFB, the Air Force learned that it had made some progress in reversing the OSD view of supporting NASA on a non-reimbursable basis. In late January, when the Air Staff coordinated the Vandenberg guidance, Col. C.J. Kronauer, DDR&E assistant director for ranges and space ground support, found no objections to it. He stated that a DOD review of national range policy was under way and would likely incorporate the USAF views on reimbursement.[29]

The Air Force in Project Apollo

(U) Even though the Gemini project was just getting into full swing in 1964, NASA was already busily engaged in the next phase of its moon venture--the Apollo project. Just as in Mercury and Gemini, the Air Force would play a significant supporting role and participate in the experimental phases of Apollo.

Support Requirements

(U) During the latter part of fiscal year 1964 the precedent of a range tracking ship agreement and continued Congressional interest in consolidation of resources had led NASA to seek DOD assistance in providing instrumented aircraft to support the injection phase of its Apollo operations. A National Range Division study completed on 28 May 1964 defined a need for 12 C-135 type aircraft to allow telemetry recording and voice communication with the Apollo lunar vehicle for 10 minutes after a launching. AFSC could make eight aircraft available, while the other four could come from KC-135 production.[30]

(U) In the early part of the new fiscal year, the need date for the first two modified aircraft was advanced from 1 January 1967 to 1 July 1966. After study within DDR&E and consultation between it and NASA, the space agency transferred $600,000 to AFSC's Electronic Systems Division (ESD) to initiate

the work. OSD approved the preliminary technical development plan soon afterward, and the definition phase got under way on 23 April 1965. The time schedule was becoming critical if the first aircraft were to be available in July 1966 to support the unmanned Apollo flights. Funding was predominantly a NASA responsibility, with the Air Force paying only for equipment needed beyond the Apollo requirements. However, financing agreements had not been worked out at the end of the fiscal year.[31]

(U) Also, about the middle of the fiscal year, DOD agencies began to get their first real inkling of the scope of the Apollo recovery requirements. On 11 January 1965 General Huston circulated a copy of the NASA Manned Spacecraft Center's "Preliminary Recovery Requirements for Project Apollo."[32]

DOD Participation in Apollo Experiments

(U) It first appeared that NASA's invitation to the Air Force in May 1964 to participate with on-board experiments in Apollo would serve no purpose because there was insufficient time to prepare for the early flights--204 and 205--to meet NASA deadlines for experiment data, and the later flights--208 and beyond--were not sufficiently firm. Late in October 1964, however, Air Force interest in the early flights revived as SSD's Houston Field Office identified three possible experiments which seemed feasible for installation on Apollo 204 and 205. Two of these, Autonomous Navigation and Radiation Measurements, were continuations of Gemini experiments, while the third, a meteorological experiment, was procedural in nature and involved no equipment. The hardware and funds were avilable within AFSC, and NASA had informally indicated they could be accommodated. On 20 November 1964 AFSC formally recommended their approval by Headquarters USAF and the Manned Space Flight Experiments Board, but the Air Staff held up action pending receipt of additional justification.[33]

Military Uses of Space: 1946-1991

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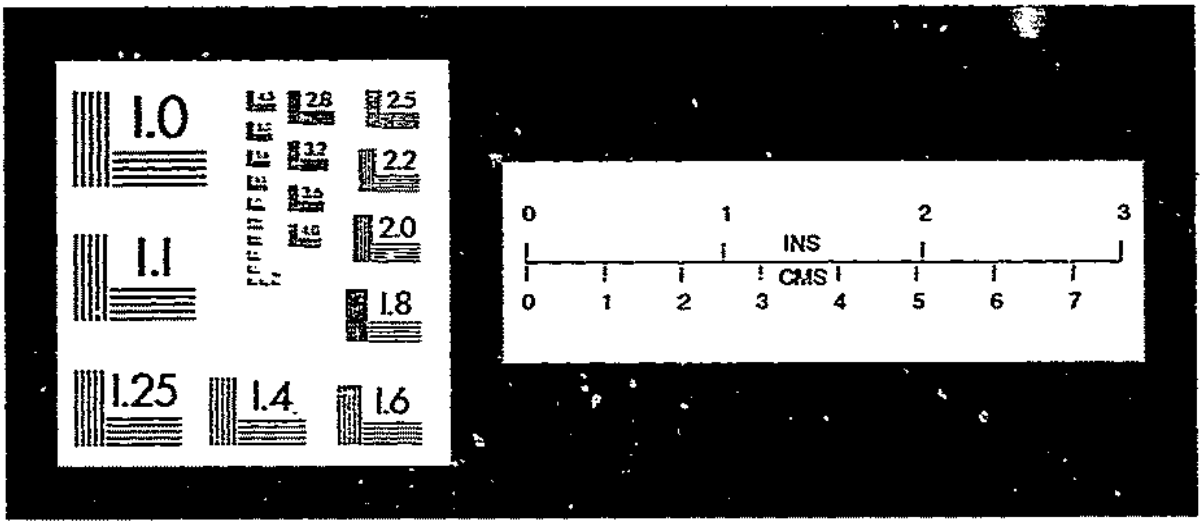
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(U) After the Directorate of Science and Technology identified funds and laboratory support, on 18 March Dr. Brown approved inclusion of the three experiments on the Apollo 204 and 205 flights.[34]

(U) In the meantime, on 8 March AFSC had proposed a fourth experiment, Solid Electrolite Carbon Dioxide System, for the two early flights. AFSC's Aerospace Medical Division was prepared to fund the work as part of its bioastronautics research. Dr. Brown approved a month later and on 15 April the Air Staff authorized AFSC to proceed.[35]

DOD-NASA Agreement on Collocated Tracking Facilities

(U) A DOD-NASA agreement in January 1963 outlined the managerial and operating rationale for the facilities in the Cape Kennedy-Merritt Island complex. In the period between that agreement and fiscal year 1965, General Davis and Edward C. Buckley, director of NASA's Office of Tracking and Data Acquisition, vainly sought a management and operating agreement for the downrange tracking stations where NASA and DOD facilities were collocated.[36]

(U) Unable to break the stalemate, the Air Force on 19 November 1964 appealed to DDR&E to intercede and reopen negotiations at the DOD-NASA level. After additional discussion at all levels, Dr. Brown informed Under Secretary McMillan on 16 April that DDR&E had agreed to transfer management of the Kokee Park, Hawaii, tracking station, for which NASA had long expressed a special interest. He also noted that DOD and NASA would jointly study network station activities at Antigua and Ascension Island under single management of DOD, under separate management, and under other possible alternatives. Finally, the basic agreement prepared by Mr. Buckley and General Davis on management of the joint interest network stations was

modified slightly and adopted by Drs. Brown and Seamans. Dr. Brown directed the Air Force to prepare a transfer plan for Kokee Park, effective 1 May 1965, and review the basic agreement by 23 April. Under Secretary McMillan signified Air Force acceptance on 26 April.[37]

(U) In consequence of these actions, on 18 May 1965 Drs. Seamans and Brown concluded a formal agreement on the collocated land-based tracking, data acquisition, and communication facilities. Several fundamental policies underlay the agreement. Responsibility for development, procurement, installation, and checkout of mission-oriented facilities directly associated with the launching and inflight control of either agency's missiles, launch vehicles, or spacecraft would rest with that agency. DOD would have the same responsibility for general purpose facilities of the national ranges in support of the launch programs of both agencies. In planning support for new programs, both agencies were to consider fully the use of existing facilities. Likewise, major modifications or additions to its facilities by either agency must be coordinated with the other to avoid duplication and insure that requirements of both agencies were properly considered.[38]

(U) The agreement called for the major user at collocated facilities to assume single management of base support. It would also assume management of certain common-use technical equipment and services in support of the instrumentation facilities of both agencies. As a result, DOD became the base support manager at Grand Bahama, Grand Turk, Antigua, Ascension Island, and Vandenberg AFB, and NASA at Kokee Park and Bermuda. As probably the major compromise of the negotiations, the respective support base managers also took on the responsibility to operate and maintain collocated instrumentation facilities, although the agreement provided for a joint study of exceptions.

(U) Operational control of tracking, data acquisition, and communication networks used in making mission decisions would not be shared.

Consolidation of Supply Management in the Cape Kennedy Area

(U) On 16 March 1964, as the result of its investigation into Atlantic Missile Range operations, the General Accounting Office (GAO) recommended single management over common item supply support at NASA's Merritt Island Launch Area and USAF's Cape Kennedy station. Officials had already begun to discuss the matter in September 1963 as the drift of GAO's findings became evident. By May 1964 a broad agreement had been reached, and on the 14th of that month Robert H. Charles, Assistant Secretary of the Air Force for Installations and Logistics, and John Young, NASA's Deputy Associate Administrator for Administration, formally agreed that the supply activities in question would be consolidated under Air Force management. After some delay over local issues, General Huston and Dr. Kurt Debus, Director of the Kennedy Spacecraft Center, signed the joint procedures agreement on 30 June 1965. In its final form, the agreement provided for gradual DOD assumption and a year for contractor employees to be assimilated in other jobs or transfer--a prudent provision designed to forestall political and labor objections.[39]

Military Flight Training for NASA Astronauts

(U) Flight training of certain NASA personnel was yet another area in which DOD assisted NASA. On 27 January 1965 Dr. Dryden asked Deputy Secretary of Defense Cyrus Vance to assist NASA by providing jet flight training to a group of scientist-astronaut candidates. After reviewing Navy and Air Force bids for the job, Mr. Vance assigned the task to the Air Force

and on 1 March, suggested that Dr. Dryden make arrangements with Secretary Zuckert. As Secretary Vance noted, the major advantage of the Air Force training lay in the fact that the student ended up flying the T-38, the same airplane that NASA was then procuring for continuation flying training. On 10 April Secretary Zuckert offered NASA 20 spaces in classes at Williams AFB, Ariz., beginning 7 September, 18 October, or 1 December 1966.[40]

III. THE AIR FORCE ANTISATELLITE PROGRAMS

[redacted] During fiscal year 1965, as the Program 437 [redacted] moved toward operational status, the Air Force realized that any succeeding system would only be an extension of 437. This stemmed from a number of factors: [redacted] the high cost of a new system. Therefore during the latter part of the fiscal year the Air Force proposed two possible variations.

The Air Force submitted a program change proposal for it to DDR&E on 15 April 1964. The other, described in a preliminary technical plan forwarded to DDR&E on 11 May, [redacted]

The Operational Program 437

[redacted] The basic 437 program incorporated Thor missiles [redacted] a nonorbital, direct interception trajectory. [redacted] integral part of 437. An initial operational capability, attained on schedule on 29 May 1964, provided the United States with an opportunity to intercept any satellites up to [redacted]

[redacted]

Never intended by the Air Force to be anything but an interim system, [redacted] However, like the first Atlas missile declared operational at Vandenberg AFB in September 1959, it had certain [redacted]

[redacted] Air Defense Command (ADC) successfully exercised the 437 system in operational tests twice during fiscal year 1965. In the first instance, on 18 November 1964, a dual countdown of the launchers was routinely completed, liftoff was on time, and flight performance met all objectives. The tracking [redacted] the payload [redacted] the design parameters of the system. The Air Force obtained even better results on 5 April 1965 when ADC again exercised the system. In its flight [redacted] the payload [redacted]

Thus, to the end of fiscal year 1965, Program 437 had enjoyed five completely successful launches out of six attempts, only the 29 May 1964 demonstration launch having been marred by a booster malfunction.[2]

The Evolution of 437

[redacted] program proposed by the Air Force to DDR&E on 15 April 1964 was more an extension than a follow-on to the existing system. Its objective was to obtain greater program flexibility by incorporating

[redacted]

[redacted] The Air Force proposed a four-launch demonstration effort to begin nine months after approval, followed by an operational phase that called for five launches annually. Both the development and operational versions would utilize the same [redacted]. Only minor modification to existing launchers and blockhouse was required but there was need for new [redacted] facilities. The Air Force estimated the following costs: a $14.7 million increase in RDT&E funds in the 1964-66 period, $34.7 million in investment funds, and a $1.7 million increase in annual operating costs. The Air Force sought immediate go-ahead of the RDT&E effort--with the money coming from 1964 OSD emergency funds. It also requested approval by October 1964 to proceed on the operational capability and insure its availability upon completion of the demonstration phase.

[redacted] Twice during the remaining months of the fiscal year, Under Secretary McMillan urged DDR&E to approve the work. Apparently, a major problem was the fact that during OSD evaluation, the system's potential users, as Dr. McMillan noted, "were not very articulate in expressing [redacted] since they have not had experience with them." However, as he observed, experience indicated [redacted] triggered enthusiastic expressions of need for more. The Under Secretary finally urged, on 23 June, that OSD at least approve the RDT&E phase plus five operational payloads and boosters at an increase of $23 million to the basic 437 authorization.

[redacted] Deputy Secretary of Defense Vance on 4 August 1964 agreed in part to Dr. McMillan's latest proposal, approving the RDT&E portion. However, he specifically disapproved an operational system until development results were fully assessed. Mr. Vance denied use of emergency funds, directing the Air Force to reprogram the additional $17.5 million for 1964-65 from its own

[redacted]

resources. There should be, he added, no irrevocable decisions on construction and operational investments before the [redacted] had been successfully demonstrated. On 8 August DDR&E approved the revised 437 program of $17.9 million for fiscal year 1964 and authorized a first increment reprogramming of $1.9 million from the [redacted] project.

[redacted] On 6 August 1964 the Air Staff directed AFSC to get the work under way. By this time, however, delays had invalidated previous contract negotiations and cost estimates which had been based on sharing expenses with the basic 437 program. Renegotiations were time consuming, and it was not until 30 December that AFSC submitted new figures. It estimated that 1965 requirements were $4.128 million more than authorized by OSD. In February 1965 Headquarters USAF advised AFSC that the increase would also have to come from reprogramming. The funds were eventually obtained from the Standardized Space Guidance System and Laser Radiation Technology projects.

[redacted] Of more immediate inconvenience to the Air Force were DDR&E's continued delays in releasing the remainder of the proposed reprogramming of 1964 funds. Although DDR&E was aware of the pressing need to have the deferred funds on hand by 1 November--having received information copies of all correspondence between the Air Staff and AFSC on the subject--it was not until 23 December 1964 that the funds were released.

[redacted] During the last quarter of fiscal year 1965, the Air Force attempted to forestall the 11-month hiatus which would inevitably follow from the OSD directive to complete and evaluate the flight test series before proceeding into an operational phase. By early April, as Maj. Gen. O. J. Ritland, AFSC Deputy Commander for Space, pointed out to Maj. Gen. Richard D. Curtin, USAF Director of Development Plans,

[redacted]

had passed the halfway point on schedule with excellent results. [redacted] subsystems tests had been completed, system performance had been revalidated, and no major technical problems were foreseen. Moreover, the basic 437 system had been successfully exercised twice since the beginning of the alternate effort.

Consequently, with the deadline for long lead-time procurement approaching, General Ritland felt the Air Force ought to ask OSD to review its decision of August 1964.

[redacted] As matters then stood, [redacted] launches were scheduled between August and December 1965. Assuming a favorable follow-on decision between October and December, the Air Force would not obtain the first operational system until September-November 1966. Among numerous accruing disadvantages under these circumstances would be the 11-month delay in reexercising the system; loss of competent contractor engineering, manufacture, and launch support teams; and associated startup costs.

[redacted] General Ritland suggested a possible alternative. If OSD acted promptly, it could eliminate the cited disadvantages by authorizing procurement of long leadtime hardware [redacted] This limited procurement would also permit the Air Force to launch the three vehicles either in training exercises or operationally, use them to test fly payload changes and improvements, and provide a stabilized testbed [redacted]

[redacted] General Ritland estimated the cost of the three payload vehicles at $3.3 million, but he thought that procurement could be arranged to limit government obligation during the decision period--through December 1965--to about $2.4 million. If OSD then decided against the operational phase, the Air Force would recover part of the funds.

[redacted] The Air Staff and Dr. McMillan found the proposition attractive and strongly recommended that DDR&E approve it. They identified a source to meet the May deadline that General Ritland had established for the initial $400,000 and promised to make the remaining 1965 funds available through normal reprogramming. Although Dr. McMillan secured informal support from the DDR&E staff, OSD had not reacted officially by the end of the fiscal year.[9]

The Follow-on Effort:

[redacted] Concurrently with the 437 and 437AP activities, the Air Force initiated a 437 follow-on effort,

DDR&E had approved a preliminary development plan late in fiscal year 1964. The described by a program change proposal of 22 July 1964,

capable of destroying hostile satellites

The USAF proposal called for Phase I system definition and Phase II development and test--the former being essentially a design study competition and the latter an 8-launch program ending about mid-1968.[10]

[redacted] Secretary McNamara on 1 October 1964 indicated no urgent requirement for the system, a reversal of his earlier position, but conceded that the system was technically feasible, the approach sound, and the system potentially useful in certain postulated international situations. On this basis, he was only willing to approve the conduct of Phase I. The Secretary authorized the use of the remaining fiscal year 1965 Follow-on Antisatellite funds--$2.1 million. Any additional action would depend on the study findings, current performance, and the existing threat. Mr. McNamara also directed the Air Force to coordinate fully with DOD's Advanced Research Projects Agency (ARPA) and the other services to assure utilization of previous work in this area. On 3 November DDR&E released the $2.1 million.

[redacted] The Air Staff on 12 October directed AFSC to undertake the design competition based on a nonnuclear, resources, including facilities, boosters, and launch crews. In designing the vehicle, consideration was also to be given to such other boosters as Minuteman and Polaris and to a guidance subsystem that could be utilized by Nike-Zeus. The desired Phase I product was a detailed procurement package that would lead to Phase II development and test.[12]

[redacted] On 26 November, during a review of all 437-related efforts--in which he expressed great satisfaction--Assistant Secretary Flax stated that he wanted Air Staff, AFSC, and SSD representatives. Conscious of the intense review to which OSD and the Joint Chiefs of Staff (JCS) had Secretary Flax was headed in an acceptable direction. Consequently, the Air Staff directed AFSC to ready a presentation for the week of 17 December and be prepared to issue Requests for Proposals thereafter.

[redacted] Unfortunately, in the interim between the 26 November review and the 18 December briefing, the rationale of the SSD approach had changed. SSD called for an effort under management procedures, with Aerospace Corporation as the technical director, and for conceptual design studies based on several postulated threats--all of which had previously been discarded. Concerned with this approach, Secretary Flax and the Air Staff asked to review the work statements before they went out to industry.

[redacted] SSD also indicated a strechout of four months over previous scheduling. As the Director of Development Planning saw it, this delay had stemmed from the need to establish the management team because the basic tasks remained the same. General Curtin suggested a few days later that the

[redacted]

briefing indicated "a lack of understanding regarding the intent, scope, and objectives of this design effort."

On 21 December SSD supplemented the briefing with an estimate of additional funding required in connection with the adjusted schedule. General Curtin rejected it, reasserted that $2.1 million would have to cover the design effort, and again chided AFSC on "misunderstanding" the management procedures for the program. He also pointed out, as the Air Staff had several times, that the Air Force needed funding data to work into the 1967 budget cycle and this could only be obtained at the completion of the design effort. General Curtin repeated the guidance so often expressed by Secretaries McMillan and Flax that the procedures "employed so successfully on the original 437 R&D program, both as to internal project management and as to full and concurrent flow of guidance among all concerned levels (SSD-AFSC-Air Staff-SAFRD-DDR&E) was the procedure expected and recommended for 437Y."

During a meeting on 4 January 1965, Air Staff and AFSC representatives again sought to resolve the management problems. A few days later, General Curtin summarized the Headquarters USAF position for AFSC and SSD: Although following successful flight demonstration, this goal could only be reached by a step-by-step approach. Accordingly, had to be limited to the first step in the system; OSD and the Office of the Secretary of the Air Force (OSAF) would consider nothing else. Likewise SSD's financial estimates were out of line with those of the higher echelons. DDR&E had in mind a three-year, $50 million effort; the SSD approach involved approximately $300 million.

Program 437 had management procedures, and Aerospace Corp. had not had technical direction over the contractors.

[redacted] Yet another factor was the Navy's capability based on the use of Polaris missiles launched from ships. At the estimated program cost of $35 million, it was [redacted] the Air Force's. Another Navy [redacted] would cost approximately $50 million. Headquarters USAF knew that the technical aspects [redacted] sound and attractive to DDR&E. Thus, if the Air Force hoped to conduct [redacted] it must adhere to OSD guidance.

[redacted] During the second week of January, an Air Staff representative assisted SSD in preparing the proposal and work statements. Managerial differences were sufficiently resolved so that on 12 February, when SSD again presented its plans, they satisfied the Air Staff and Secretary Flax. Consequently, on 17 February General Curtin approved the release of the Requests for Proposal and asked for a completed package in time for the 1967 budget cycle. On 12 May the Air Staff was able to report to ARPA that the first step--if about two and a half months late--had been taken with the selection of three contractors for the design competition.

[redacted]

[redacted]

IV.

The resulting development effort eventually evolved into three separate projects, one of which incorporated the concept of utilizing infrared sensing devices in satellites. From 1958 the infrared concept was pursued as the Missile Defense Alarm System through numerous reorientations occasioned variously by technical and financial limitations. By fiscal year 1965 the Air Force was convinced that both a valid and urgent national requirement existed and that its was admirably suited to fill this need.

[redacted] Following a successful test demonstration in 1963, OSD had agreed that should continue but supported it with meager RDT&E funds only. By mid-1964, with sizable funds already invested in three proposed 1966 launches and fearful that the $10 million tentatively allocated by DDR&E for fiscal year 1965 would not sustain the technical and industrial base until the launchings took place, the Air Force submitted a program change proposal and technical development plan that described a compromise effort costing $26.9 million.

The 1965-67 Program Approved

[redacted] As described by Secretary Zuckert, "it was a minimal program based on already incurred investments and aimed at preserving both near and long-term reoriented objectives, but with some slippage in schedule and an increased technical risk." Basically, the program consisted of two overlapping phases. The first involved 11 Research Test Series (RTS) launches

[redacted]

in three series, to begin in January 1966 and end in 1970. The second phase, between January 1967 and November 1969, involved seven Detection Test Series (DTS) launches in two series which hopefully would meet the reliability goal of one year mean time before failure (MTBF) and also provide a useful

Secretary McNamara's decision of 27 August 1964 in effect approved the Air Force proposal, including the $26.9 million, but he also directed the Air Force to reduce the number in the first series of DTS launches (DTS-I) from four to three. He based the reduction on the predicted high reliability of the series (at least 75 percent per launch) and the fact that

The Secretary also ruled that the receiving station--which the Air Force proposed to reactivate for tracking and data reduction--should be limited to data recording only.

Secretary McNamara could not justify providing real-time data processing and displays Mr. McNamara did not approve any funding beyond 1967 because he thought that the Air Force had not sufficiently defined the satellite series planned after RTS-I and DTS-I.

The Air Force reprogrammed the additional funds (18 million) for 1965 from the Manned Orbital Laboratory program on 15 October, and DDR&E released them on 27 October 1964. As now approved, the objectives of the program, in addition to the basic task of providing

After using it in the 1963 series of launches, the Air Force had put the station into caretaker status.

[redacted] To meet these objectives, the Air Force would launch initially three RTS and three DTS payloads. The RTS-I satellites, to be put into [redacted] orbits by Atlas-Agena between January and May 1966, would have the [redacted] capability. Also during their expected six months of life, they were to exercise a [redacted] capability [redacted] The DTS-I satellites, to be launched between January 1967 and April 1968, would perform essentially as the RTS-I's, but would have a quasi-operational status. They would demonstrate a full year MTBF capability and furnish data to the readout station [redacted] They would provide approximately 20-25 percent coverage of areas of interest and a degree [redacted] in addition to giving the Air Force some operational experience with such a system.[6]

New Financial Restrictions and Reorientation Again

[redacted] Soon, however, the historical pattern began to assert itself and OSD forced the post-1965 program into a reorientation. During fiscal year 1966 budget discussions in early November 1964, DDR&E tentatively proposed funding reductions to $40, $80, $50, and $20 million (from $50, $100, $80, and $50 million) for fiscal years 1966 through 1969 respectively. Despite an Air Force reclama on 20 November, the reductions were confirmed with the publication of the DOD Five-Year Force Structure of 21 December 1964. The major impact of these decisions, as the Air Force

had foretold in its reclama, was the necessity to drop the three DTS-I launches. This introduced extremely high risks in achieving those objectives that depended on both the RTS and DTS satellites. Of particular concern were the few vehicles available to test the radically changed design and the potential loss of the already large investments. Moreover, the Air Force could not immediately establish the one-year MTBF, it would not acquire operational experience, and the operational fallout would be considerably less than that anticipated in August. Thus, would revert almost entirely to development status.

[redacted] Beginning on 24 December 1964, the Air Staff and AFSC sought means of achieving the program goals within the reduced funding. In directing AFSC to evaluate ways to carry on the program, the Air Staff explicitly suggested that the three-launch RTS-I schedule be protected. AFSC planned both in-house and contract definition studies, but lost several weeks when its Aerospace technical advisors, despite Air Staff guidance prepared Requests for Proposals which Headquarters USAF knew DDR&E would not approve. Basically, the issue was whether the contract study should be a one- or two-step effort. Under the first, the sensor contractors would provide a single, integrated package oriented toward total system configuration; in the two-step approach, the contractor would first define sensor development, then orbital equipment, and Aerospace would then integrate the findings. Both DDR&E and the Air Staff favored the one-step study because the other approach would tend to restrict the contractors' imaginations and channel their efforts toward isolated goals. Thus, when SSD on 11 February 1965 proposed the two-step study, DDR&E rejected it.

[redacted] SSD presented a revised system-oriented proposal on 23 February, and the Air Staff and DDR&E immediately approved it. The

[redacted]

following day AFSC was authorized to proceed with contractor and in-house studies to establish an RTS-II configuration and program within the financial restrictions. Eight firms responded with proposals in mid-April. These encompassed a wide variety of approaches. Two were oriented toward synchronous orbit, three toward medium altitude, and three were flexible. They also presented numerous concepts in attitude stabilization, power sources, data reduction, sensors, and communications. In mid-May, the Air Force selected Hughes Aircraft Corp., Space Technology Laboratories, and Lockheed Missile and Space Co. to undertake the studies, to be completed by 14 September 1965.

Delays in the Approved Program

While these actions to revise the RTS-II effort were under way, technical problems and labor troubles coalesced to delay the RTS-I portion, which during the fiscal year was concentrated on the fabrication and bench testing of the payload packages. Lockheed experienced considerable technical difficulty with certain sensor components and was late delivering to the sensor contractor, Aerojet-General. This forced AFSC to revise the RTS-I launch schedule from January, March, and May 1966 to February, May, and July. No sooner had AFSC published this schedule, however, when a labor walkout at the Aerojet-General plant where the three payload packages were being built, made a further postponement likely. Initially, supervisory personnel continued the work at about half the normal rate, but it was unlikely that they could maintain this pace beyond 30 days.

Although not affecting schedules, still another problem late in the fiscal year concerned the Atlas-Agena D launching pads at Vandenberg AFB. On 10 March 1965, AFSC advised Headquarters USAF that this had been preempted by a higher priority program and was no longer available to The only other open facility was configured for the Atlas-Agena B, was

currently in caretaker status, and would cost approximately $1.5 million to reactivate and modify. The Air Staff immediately authorized $400,000 to start the job and, in early June, secured DDR&E approval to reprogram $1.5 million from the Advanced Space Guidance program.

In the meantime, following elimination of the planned DTS-I launches, AFSC thoroughly evaluated the readout station--intended to support the DTS flights--and found that it would serve equally well for the RTS-I operations. Headquarters USAF on 20 May concurred and authorized AFSC to activate the station on a "record only" basis.

Coordination of

Late in fiscal year 1964, ARPA planning for future Vela satellites* had emphasized the need for a capability to space. Since such a capability involved many DDR&E recommended personnel exchange information and evolve a coordinated research and technology program Following a 15 September 1964 meeting of representatives from ARPA, DDR&E, the Air Staff, AFSC, Aerospace, and DDR&E requested the Air Force and ARPA to evaluate jointly in more detail

With ARPA concurrence, AFSC conducted the requested technical evaluations and presented its findings along with an abbreviated technical development plan to Headquarters USAF during the week of 14 December. The Air Staff concurred in the AFSC recommendation

[redacted]

be flown on the second and third [redacted] satellites scheduled in 1966. Not only would this provide an early and realistic demonstration of the potential [redacted] but it would permit earlier evaluation of [redacted] and augment a [redacted] test planned on NASA's Advanced Technology Satellite.

[redacted] On 22 December Assistant Secretary Flax forwarded the proposal and abbreviated plan to DDR&E which approved it early in January 1965. On 6 January ARPA made $1.2 million available for fiscal year 1965, while the Air Force planned to use about $400,000 of its funds from fiscal year 1966. Two days later, AFSC received authorization to proceed on the joint effort.

[redacted]

[redacted]

V. DEFENSE COMMUNICATION SATELLITES

[redacted] Although OSD had approved two new communication satellite projects in fiscal year 1963 to replace the discredited Advent, there was little progress on them during the following year. Program 814, a proposed synchronous orbit system, was suspended for lack of funding. The Air Force however, completed the definition phase for Program 369, the random orbit system, and selected a contractor team. But then OSD, in hopes of saving money, procrastinated while it looked into the possibility that the new commercial organization, Communications Satellite Corporation (ComSatCorp) might be able to satisfy DOD's needs. The entire fiscal year was spent in fruitless negotiations before OSD concluded that this approach would not work.

[redacted] During the ComSatCorp negotiations, the Air Force persuaded OSD to approve its selection of the Philco Corporation (Western Development Laboratories)-Space Technology Laboratories (STL) team as the development contractor. The contract was let in November 1963, but it was not until 14 July 1964 that Secretary McNamara announced that DOD would "proceed with full development of a separate system."[1]

[redacted] With this restraint removed, the Air Force and other DOD agencies actively explored several kinds of communication satellites. By the end of fiscal year 1965, they had grouped the various systems into two broad categories: point-to-point strategic systems and mobile, tactical systems. The former included the Initial Defense Communication Satellite Program (IDCSP), the Advanced Defense Communication Satellite Program (ADCSP), and the Syncom satellites; the latter, Programs 591 and 244.

The Initial Defense Communication Satellite Program*

[redacted] On 29 June 1964, with the ComSatCorp negotiations definitely foundering, OSD directed the Air Force to obtain firm bids on a slightly revised approach which it had informally described late in May. Following a 30 July briefing on the Air Force proposal, on 4 August OSD gave the go-ahead on the reoriented approach which took advantage of the now apparently successful Titan III development.[2]** DDR&E authorized the Air Force to negotiate with Philco to obtain contractual assurance of a $22-million IDCSP,† featuring 18 to 24 satellites deployed into a high altitude (18,000 to 18,500 miles) near-synchronous equatorial orbit. However, the satellites and their dispensers were to be designed flexibly to permit launching by either the Titan or, as originally planned, by Atlas-Agena into a 5,000-mile random orbit, should the Titan III not be available. The design goal of the communication satellites was a three-year lifetime, with a minimum laboratory-demonstrated lifetime of one and a half years. The Air Force was authorized to procure 24 satellites and three dispensers and to plan for the first of the three launchings in February 1966. The $22 million would be released upon receipt of Air Force assurance that the effort could be accomplished within this ceiling.[3]

[redacted] Although introducing no new technical difficulties, the Air Force's negotiations with its contractor disclosed that the project would cost

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* Defense Communications Agency documents refer to both the IDCSP and ADCSP as "projects"; Air Force documents call them "programs." This monograph follows Air Force usage.

** For the Titan III story, see the following chapter.

† The $22 million was the approximate residue of the $52.3 million deferred Program 369 funds originally authorized in 1963 (in turn, the Advent residue).

approximately $30 million, almost 20 percent more than the OSD ceiling. On 19 October Dr. Fubini advised that OSD would support a $28,530,000 program and released $23.77 million at this time (other funds had been provided earlier).[4] On 23 November he approved the formal USAF program and procurement plans that he had previously requested.[5]

[redacted] The IDCSP was the direct descendent of Program 369, using its funds, its managerial framework, and its contractor teams--although 369 had started out as a random-orbit, medium-altitude system while the IDCSP was a near-synchronous, high-altitude effort. On 23 April 1965 the Air Staff formally defined Program 572, as it now became identified, in a new system program directive. The orbital altitude was established at 18,200 miles. The total payload weight, including eight satellites and a dispenser, would be a maximum of 1,022 pounds. Each satellite, powered by solar cells, would have two full duplex voice channels operating on a bandwidth of 20 megacycles and contain a microwave repeater and frequency translator capable of receiving radio signals from and transmitting them to Army-furnished earth terminals.[6]

[redacted] Following the successful initial Titan IIIC launching on 18 June 1965, the Air Staff and AFSC agreed that it was no longer necessary to keep the Atlas-Agena alternative open and allowed the backup contracts to expire at the end of the year. Dr. Fubini several months earlier had authorized the Air Force to reprogram the Atlas boosters to other purposes.[7]

Secondary IDCSP Payloads

[redacted] By the end of fiscal year 1965, it had become obvious that the second and third sets of Program 572 spacecraft would also carry other experimental payloads. With the decision to drop negotiations with ComSatCorp, OSD authorized the Air Force to reopen negotiations with NASA on the subject

of gravity gradient stabilization (GGS) of the satellites in place of spin stabilization.* On 23 October a NASA-DOD agreement stipulated that NASA would transfer $5 million to the Air Force to conduct such an experiment. DDR&E authorized the Air Force to procure two early GGS satellites from General Electric to be flown early in 1966. The first satellite would be put into orbit by the same Titan IIIC used to orbit the second set of communication satellites in April 1966. Only if the first experiment failed would the second GGS sateilite be launched along with the third set of communication satellites in June 1966.[8]

[redacted] On 3 June 1965, after USAF and ARPA investigations established feasibility and desirability, OSD authorized the Air Force to [redacted] Also, by the end of the year the Air Force had recommended that a despun antenna test satellite be carried on one of the three launchings to obtain data for solving the problem of orienting the antennae and other sensors toward earth as a satellite spun through space.[9]

[redacted]

The Advanced Defense Communication Satellite Program

(U) While the IDCSP and other developments would provide a satellite communication capability through the late 1960's, DOD officials thought that a more advanced system was needed for the 1970's. On 1 October 1964 the Defense Communications Agency (DCA) completed a program plan describing acquisition of an ADCSP. It called for immediate initiation of definition phases for operational and technical requirements and systems. Definition of the operational and technical requirements would be a three-month effort

* For background on this subject, see Cantwell, pp 72-73.

[redacted]

and the system definition study would extend for nine months.[10]

(U) On 18 December, Dr. Fubini approved the conduct of definition phase studies, based on validated JCS requirements. Following a 2-5 November conference of major air commands at which Headquarters USAF's Directorate of Command Control and Communications and the Air Force Communications Service established the ground rules, commands submitted their requirements for satellite communications. The Air Staff combined and refined these and submitted them to the JCS on 12 January 1965.[11]

[redacted] The Air Force document accepted the reality that the satellite system would be limited to meeting military requirements that could not be satisfied technically or economically by other communication media.

The user-to-user mode would provide greater survivability and reliability and not require complex ground interconnecting circuits.

[redacted] The Air Force suggested five operational areas that could best be served by satellite communications: alert and execution, force operation, range support, command control, and crisis management. The Air Force substantiated each with specific requirements from the commands. For example, both ADC and SAC outline circumstances in which satellite communication would facilitate their operations in case of a space-launched attack.

[redacted] Based on the stated needs of all DOD agencies, the JCS at the close of the year submitted a program to the Secretary of Defense which divided the requirements into two time periods: those to be met in

[redacted]

1968-70 by the ADCSP and commercial satellites, and those more complex in nature that could not be fulfilled until 1970-75.[12] The JCS recognized that existing technology might not permit complete fulfillment of the requirements within the time postulated and proposed evolutionary progress toward them, agreeing to establish priorities for those which DCA could not incorporate into the ADCSP.[13]

(U) During March the Air Force assisted DCA in evaluating industry proposals, and on 15 June the latter awarded contracts to six firms to conduct parallel system design studies for the ADCSP. The fixed price contracts ranged in value from $135,000 to $196,000.[14]

The Transfer of SYNCOM II and III to DOD

(U) On 31 December 1964 DOD formally agreed to accept technical and managerial control of SYNCOM II and SYNCOM III from NASA. The two communication satellites, launched into 22,300-mile synchronous orbit from Cape Kennedy on 26 July 1963 and 19 August 1964, had done their jobs, and the space agency had learned a great deal from them.[15]

(U) The two agencies had previously discussed such a transfer, and on 29 October, Dr. Seamans proposed that DOD assume complete control of the two satellites after 1 January 1965. He also suggested turnover of the NASA-owned telemetry and command stations and range equipment for the duration of Syncom useable lifetime. Thereafter, NASA would only want certain telemetry and range data and technical status reports on a regular basis to permit continued evaluation of the spacecraft and their components.[16]

(U) OSD accepted the NASA offer and designated DCA as its manager. DCA in turn requested the Air Force to perform the telemetry, tracking, and control functions, which in turn were assigned to AFSC's Satellite Control Facility. To prepare for Syncom operation, the Air Force relocated

the telemetry and command equipment from the Kingsport Victory to SCF's Indian Ocean Station, the Camp Roberts equipment to SCF's Hawaiian station, and the Salisbury, Australia, gear to Clark AB in the Philippines. The Air Force agreed to relinquish the tracking function to the Army since the required equipment was inherently part of the ground communication terminal. On 29 December DCA approved the detailed Air Force implementation plan, which required budgetary support of $427,730 in 1965 funds and $53,200 in 1966.[17]

The Tactical Communication Satellite Program

[redacted] During fiscal year 1965 the Air Force also studied a general purpose synchronous satellite which eventually evolved into one whose primary purpose was tactical communications. Ultimately identified as Program 244, the project originated on 4 November 1964 when Under Secretary McMillan asked the Director of Development Plans to undertake a study of military functions which could be supported by a synchronous satellite. Among the early mission possibilities which the directorate subsequently investigated

[redacted] On 23 June the Air Staff presented to Dr. McMillan a plan and development, funding, and launch schedules which called for the first of three synchronous satellite launches to take place in April 1968. Funding required was given as (in millions): $12.3 in 1966, $53.3 in 1967, $79.7 in 1968, and $32.0 in 1969. Secretary McMillan approved the presentation and requested that program documents be initiated. He also arranged for Dr. Fubini to review the plan the same day. After being briefed, the Assistant Secretary of Defense expressed particular interest in a synchronous

orbit tactical ultrahigh-frequency (UHF) communication capability. USAF officials had noted that the proposed 50-foot antenna would provide two-way voice between the satellite and a man-pack terminal; Dr. Fubini said that he would settle for teletype if that was all he could get, but would pay for voice if it was technically feasible.[19]

Although no final decision had been made at year's end to orient Program 244 exclusively toward tactical communications, it was obvious during the several meetings and discussions on 23 June that Drs. McMillan and Fubini considered the tactical communication experiment to be more attractive than the satellite's other potential missions. One of the things that concerned the Air Force, however, was that OSD might superimpose an excessively complex management structure on the program and bring in the other services for coordination at too early a point.[20]

Program 591: the LODUS Experiment

In the fall of 1964 the Air Force asked OSD for funds so that SAC could conduct UHF experiments on using satellites to communicate with aircraft. The command specifically planned to experiment with voice communications. Although OSD did not officially reply to the request, in December Dr. Fubini informally requested the Air Force to consider the use of low data rate teletype satellites in lieu of voice for essential command and control of the bomber force. Dr. Fubini implied he might support such a teletype experiment. The Air Force gave him a qualified "yes," not wishing to become firmly committed to the teletype system since it hoped ultimately to achieve a secure voice capability.[21]

Early in March 1965 Dr. Fubini discussed his proposal during a visit with General John D. Ryan, Commander-in-Chief, SAC. General Ryan was not enthusiastic because of the operational limitations of low data

rate systems but he agreed to give the teletype system a try. On 24 March he recommended to the Chief of Staff that the Air Force proceed with acquisition of a UHF teletype satellite. He proposed to equip his airborne command post aircraft and a small number of B-52's for an operational evaluation test.[22]

[redacted] On 28 May 1965, the Air Force submitted to DDR&E a plan for an exploratory development program and asked for $1 million in DOD 1965 emergency funds. The purpose of the effort, now designated Program 591, was to investigate the capability of a UHF satellite to provide low data rate record communication between aircraft and ground terminals. Test objectives were to determine procedures that would best exploit the satellite for air-ground-air applications, measure useful geographic coverage and the effects of operating tactics and maneuvers on potential system performance, investigate crew operating procedures and limitations, develop traffic control and management handling procedures, and determine system interference caused by other equipment on the aircraft.[23]

[redacted] As approved by DDR&E on 8 June 1965, the Program 591 Low Data Rate UHF Satellite (LODUS) exploratory development program called for Lincoln Laboratories to fabricate the spacecraft, Rome Air Development Center to modify the ground terminals, and the Air Force Avionics Laboratory to modify the aircraft. The satellites were to be launched into an equatorial orbit at 18,000-20,000 miles altitude by a Titan IIIC R&D launch between September and December 1966. While the initial experiment would be limited to non-antijamming 60-word-per-minute teletype conversations, Lincoln Laboratories was to proceed with development of antijam modulation schemes for subsequent experiments.[24]

VI. TITAN III

[redacted]Fiscal Year 1965 was one of significant achievement and decision for the Titan III program. Approved in December 1962, Titan III was conceived as a standardized space launching system intended to support diversified DOD and NASA projects. Two configurations were developed which made use, in various combinations, of such major components as the Titan II ICBM liquid propellant first and second stages, a restartable upper stage (transtage), a control module, and two strap-on 120-inch solid propellent rocket motors. The initial configuration, Titan IIIA, consisting of the liquid propellant core, transtage, and control module, could place 5,800 pounds into a 100-nautical mile orbit. The second, Titan IIIC--with the 86-foot long solids strapped on--could send 5,000 pounds to escape velocity, put 2,140 pounds into synchronous equatorial orbit, or place 25,100 pounds into a 100-nautical mile (NM) circular orbit.

Demonstration Launches

[redacted]uring the year the Air Force completed four flight demonstrations of the Titan IIIA from Cape Kennedy and launched the first of the powerful "C" model. The "A" firings--on 1 September and 10 December 1964 and 11 February and 6 May 1965--were so successful that the Air Force cancelled the planned fifth R&D flight.[1]

[redacted]Only the first of the "A" launchings was less than perfect, achieving all primary and secondary objectives but failing to orbit a dummy payload. Air Force engineers determined, on the basis of an analysis of telemetry, that an onboard helium pressure valve apparently malfunctioned, preventing the third stage from sustaining sufficient thrust to orbit the 3,750-pound payload.[2]

[redacted] For all the satisfaction they derived from the successful series of "A" launches however, OSD, the Air Force, and the Titan III contractors were primarily interested in the performance and promise of the more powerful "C". On 18 June 1965, after the first attempt to launch it was cancelled the preceding day because of technical holds and bad weather, the Titan IIIC underwent a near-perfect countdown, launch, and flight. The booster placed 25,100 pounds into a 100 NM circular orbit (apogee, 100 NM; perigee, 96 NM).[3]

(U) The Titan IIIC became the world's most powerful rocket known to have been launched to date. The booster's solid strap-on rockets hurled it from the ground with a peak thrust of 2.647 million pounds, far exceeding the most powerful rocket hitherto launched--NASA's Saturn I with its 1.5 million pounds of thrust. The most powerful Soviet rocket, which orbited Voskhod I and II, was rated by American experts at 800,000-900,000 pounds thrust.[4]

(U) High government officials took due note of the historic event. Vice President Hubert H. Humphrey, in his role as Chairman of the National Aeronautics and Space Council, sent warm congratulations to Secretaries McNamara and Zuckert. He noted particularly, "The professionalism shown by those who developed and launched this new booster." Secretary McNamara added his personal congratulations. He said he had been "especially pleased with the Air Force management of this program, it sets an excellent standard for those programs which will follow."[5]

[redacted]

Evolution of the Titan IIIX

[redacted] Late in fiscal year 1964 the Air Force had begun to investigate another Titan III variant with the objective of acquiring a booster having a low orbit performance capability beyond that of the Atlas-Agena combination, but with lower cost per launch. Toward this end, it studied the feasibility of using a stripped down, non-manrated version of the Titan III core with an Agena D in place of the transtage.[6]

[redacted] On 13 July 1964 AFSC and Air Staff representatives briefed Dr. Flax on the results of their preliminary studies. They estimated that Titan IIIX could be accomplished with little technical or schedule risk and they recommended program go-ahead. On 29 July, after receiving secretarial approval, the Air Staff directed AFSC to conduct a short project definition study with contractor assistance.[7]

(U) This situation, however, was shortly complicated by receipt of an unsolicited proposal from the General Dynamics/Astronautics Corp. suggesting an "X" version of the Atlas (SLV-3X) intended to meet the same ends. In view of the large costs involved in any new development as well as the declining production orders for both the Titan and Atlas boosters, it was essential that the General Dynamics proposal be seriously evaluated. Dr. Fubini was particularly interested in the results and gave the Air Force some guidlines to apply in its study.[8]

[redacted] By 1 December Under Secretary McMillan, after an extremely searching analysis of the General Dynamics proposal, had concluded that while it had considerable merit--indeed, on the basis of cost alone it might be more attractive than Titan IIIX--it was in the Air Force's best interests to develop the Titan IIIX. Consequently, on 21 December, confirming an

[redacted]

earlier informal position, he recommended the Titan IIIX to Dr. Fubini with the SLV-3X as a standby alternative.[9]

[redacted] Dr. McMillan conceded that under the terms of the particular guidelines provided by Dr. Fubini--which assumed all payloads of interest would weigh approximately 7,000 pounds or less, thus making SLV-3X and Titan IIIX directly competitive--the SLV-3X would appear to be more cost effective. Nevertheless, for reasons beyond the particular model used by DDR&E, he recommended that DOD procure Titan IIIX. He argued that while both vehicles had growth potential, the SLV-3X involved considerable development risk while the Titan IIIX involved none. Titan IIIX growth potential was intrinsic to the building block design of the basic Titan III family. On the other hand, improvement of the SLV-3 to any marked degree would require substituting flourine-oxygen for oxygen, changing details of the propulsion system, initiating a new flight qualification program, and establishing logistic and ground support equipment for flourine.

[redacted] Secretary McMillan further pointed out that use of the Titan IIIX in fiscal year 1967 would help preserve a production base for later procurement of the Titan IIIC. In addition, it would contribute to the flight qualification of critical elements of the Titan IIIC, already established as the most economical booster for payloads in the 15,000-20,000 pound class. A decision in 1964 to protect the production base and gain operational experience with the "X" version would help assure the availability of Titan IIIC as a reliable and economic large booster in 1967.

[redacted] The Air Force Under Secretary's arguments were persuasive. On 28 December Deputy Secretary of Defense Vance approved the Titan IIIX as well as the stretchout of the basic R&D program (discussed elsewhere in this chapter). He authorized the Air Force to develop and procure 24 Titan IIIX-Agena combinations and requested a system package program (SPP) as

soon as possible. Funds required to carry out Titan IIIX-Agena development and production would be released after DDR&E approved these documents.[10]

[redacted] USAF program documents published on 8 January 1965 and submitted by Dr. McMillan to DDR&E on 26 January, described the development, test, production, and operation of the Titan IIIX. They called for modifying an existing Vandenberg AFB launch facility and procurement of an initial lot of 24 boosters and the necessary launch services. Integration of the Titan IIIX satellite vehicle system was to be performed by the user agency. Titan IIIA ground equipment at Pad 20 at Cape Kennedy would be moved to Vandenberg and the first vehicle readied for launch 18 months after program go-ahead, with production and launch rates estimated at one a month thereafter. The Air Force estimated costs at $34 million and $36 million in 1965 and 1966, plus $1.5 million in military construction funds in 1965. On 5 February Dr. Brown approved the "X" development but raised several questions about the user agencies and funding procedures. Answers to these were incorporated in the revised program documents which the Air Force issued in April 1965.[11]

A West Coast Launch Capability

(U) Although Congress had, during the 1965 budget cycle, deleted a Defense Department request for military construction program (MCP) funds for west coast launching facilities, Secretary McNamara in September 1964 directed the Air Force to initiate detailed design of a fully operational Titan IIIC launch pad at Vandenberg AFB. He authorized expenditure of $1 million from USAF 1965 funds and assumed that DOD would obtain an MCP appropriation for the purpose in fiscal year 1966. OSD expected that a 1965 design effort would minimize the interval to an initial operational capability.[12]

(U) In response, the Air Force on 30 September submitted a request for $18 million in 1966 MCP funds to construct an Initial Launch Complex (ILC) able to handle both the Titan IIIC and IIIX. The Air Force assumed that Congress would authorize acquisition of the most ideally suited site for such a complex, on the Sudden Ranch property just south of Vandenberg AFB. The primary facilities would include a launch pad, umbilical tower, mobile service tower and propellant loading system facilities. The Air Force hoped to start construction in November 1965 and complete the complex in April 1967. After installation and checkout of ground support equipment, the facility would be available for launch operations in December 1967.[13]

[redacted] In November 1964 Dr. McMillan directed the start of detailed design studies for a dual-purpose Titan III pad at Vandenberg AFB and authorized expenditure of $1.2 million for the purpose. The design was to include alternative siting on Sudden Ranch or on Vandenberg AFB. If Congress rejected Sudden Ranch acquisition, pad construction could then proceed on the base without significant delay. The design was to incorporate flexibility for expansion from the ILC to an Integrate-Transfer-Launch (ITL) facility--such as existed at Cape Kennedy--comprising two pads and a four-bay Vehicle Inspection Building.[14]

[redacted] DDR&E approved Air Force plans and on 18 May 1965 authorized reprogramming of $1.3 million for the Titan III launch facilities at Vandenberg AFB. By the end of the fiscal year, design of the ILC was 40 percent complete and design of the Vandenberg launch complex had been accomplished. The Air Force request for funds for the ILC and purchase of Sudden Ranch were included in the fiscal year 1966 budget which the President submitted to Congress in January 1965.[15]

Revival of Titan III "Blue Suit" Prospects

[redacted] In August 1962 Secretary McNamara had rejected an Air Force plan to acquire a Titan III military operator capability and, until the late fall of 1964 no amount of Air Staff persuasion succeeded in reviving the proposal. In November 1964, however, during a briefing on the Titan IIIX proposals, Brig. Gen. Joseph S. Bleymaier, SSD Deputy Director for Manned Systems, suggested to Secretary McMillan substituting Air Force personnel for contractor crews would reduce "X" costs. Secretary McMillan thought the concept had merit and two months later, after, as he put it, "testing the temperature of the water" in OSD, solicited Air Staff views on the subject.[16]

[redacted] General McConnell, the Vice Chief of Staff, pointed out to the Under Secretary on 25 January 1965 that there was a ready source of "blue suiters" on hand at Vandenberg AFB. SAC and AFSC had acquired a Titan II launch capability in connection with the research, development, test, and demonstration of that weapon system, whose booster, of course, formed the core of Titan III. Moreover, the Air Training Command had trained a cadre of technicians for Cape Kennedy Titan III sites. Since the Titan II would soon enter its operational test phase, it would require fewer personnel. Consequently, General McConnell urged Secretary McMillan to approve the use of Air Force crews for Titan IIIX launches. He argued that the Air Force should retain its competence in this area in preparation for on-coming space operations. Moreover, he felt that economies might be effected through the use of these trained crews, pointing out that this had been the case with the several Thor-boosted space programs.[17]

[redacted] An SSD comparative study, contrasting costs per launch of contractor versus military operations, disclosed that approximately the same

number of people would be required for launch operations whether military or contractor. However, because of the lower cost per man for a military force, plus the fact that a considerable amount of such support already existed at Vandenberg, military operations on the whole would cost about 25 percent less than contractor operations.[18]

[redacted] SSD subsequently submitted a preliminary transition plan, which called for assigning military personnel for the project beginning with installation of the ground system at the pad on 6 August 1965 and achieving a complete "blue suit" launch capability with the fifth firing in December 1966. At the end of the year this study was being reviewed by the Office of the Assistant Secretary of the Air Force for Financial Management.[19]

Titan III Payload and Production Problems

(U) As noted in the fiscal year 1964 history, one of the major problems with Titan III--following cancellation of Dyna-Soar--involved payloads for the booster. The Air Staff and AFSC during 1964 attempted to devise a realistic follow-on production schedule which would keep the contractor production lines operating without exceeding the actual requirement for the booster.[20]

Stretchout of the R&D Program

[redacted] The question of Titan III production was, of course, directly related to its payload customers. In October 1964 the MOL program--then only in predefinition status--with six launches scheduled, [redacted] were the most firmly identified users. A proposed acceleration of the MOL schedule then under discussion would demand boosters in 1966, a requirement that could be met by R&D boosters if the demonstration launch program were extended in time. AFSC proposed

this step to the Air Staff in October. In November, after Air Staff and DDR&E representatives had informally discussed the matter, Dr. Brown released $50 million of $100 million in deferred 1965 RDT&E funds for Titan III and directed the Air Force to submit program alternatives, including one which would delay completion of R&D by as much as six to 12 months. He requested that these alternatives allow for the needs of MOL and Program 369 and retain the IIIX option while maintaining a IIIC launch capability at Cape Kennedy for future programs.[21]

[redacted] Dr. Brown asked the Air Force to consider a Titan III R&D test program consisting of 15 flights with two additional vehicles produced and assigned to MOL. Also to be considered were the effect of concurrent IIIX development procurement, and launch operations and of limited IIIC production on any revised program. One synchronous equatorial orbit R&D flight was to be scheduled at or near the end of the demonstration launch program to provide maximum time for preparation of suitable experimental payloads. Finally, Dr. Brown asked that the Air Force identify possible funding reductions in fiscal years 1965 and 1966, with proposed funding in 1967, if any, kept to a minimum.

[redacted] Several days later, on 20 November, the Air Force proposed a revised Titan III R&D flight schedule. In forwarding it, Dr. Flax advised Secretary Zuckert that the Air Staff, uneasy about cited Titan IIIC usage rates unsupported by approved payloads, had directed AFSC to separate "C" production from the other Titan III models, thus making it severable. As far as Dr. Flax could see, the $50 million released by Dr. Brown would carry the program into March 1965.[22]

On 28 December, concurrent with approving the IIIX program, Deputy Secretary of Defense Vance authorized Secretary Zuckert to extend the Titan III R&D program an additional year in accordance with the schedule submitted by the Air Force. Mr. Vance repeated that release of remaining funds was contingent upon DDR&E approval of a formal program package. The new Titan III R&D flight schedule was as follows:[23]

Titan IIIA	Titan IIIC
Sep 64	Jun 65
Dec 64	Oct 65
Jan 65	Nov 65
Apr 65	Jan 66 (MOL Booster Checkout)
Aug 65	Feb 66 (IDCSP)
	Apr 66 "
	Jun 66 "
	Sep 66 (MOL Booster Checkout)
	Feb 67
	Apr 67 (Gemini B/MOL Spacecraft Qualification)
	Jun 67
	Oct 67 (Gemini B/MOL Spacecraft Qualification)

The Air Force submitted the required documentation to DDR&E on 1 March. Ten days later, Dr. Fubini approved the stretchout schedule but rejected the program documents, asking that they include more detailed planning and justification for the individual projects to support funding needs through 1968. He also identified other aspects which required more precise documentation. Assuming that the Air Force would comply, DDR&E on 12 March authorized release of the remaining $50 million in 1965 funds.[24]

The Air Force, however, was unable to furnish all the requested information until contracts for the stretchout program had been negotiated, and this was a time-consuming effort. During the first four months of 1965 it studied six different proposed alternate stretchout programs.

[redacted]

On 13 May Dr. Flax informed Dr. Fubini that contract negotiation would extend until mid-June; consequently the detailed data desired by DDR&E would not become available until sometime in July. In the interim, however, Dr. Flax submitted a status report on the specific points Dr. Fubini had raised.[25]

[redacted] On 24 May the Air Force completed a program change proposal (PCP) which described both the R&D stretchout and the IIIX plan and formally recorded the OSD decision of 28 December. As noted in the PCP, the objective of the stretchout was to assure continued availability of solid motor hardware by providing for a minimum production of critical components and additional development test firings, requalifying (as necessary) guidance and transtage components, and maintaining a minimum Titan III launch capability at the AFETR from June 1967 to April 1968. This proposal, requiring an additional $47 million for 1967-68, was approved by OSD on 2 July 1965.[26]

The Follow-on Production Plan

[redacted] As stated above, the stretchout of the R&D program was but one aspect of the major overall problem of Titan III production. Concurrently, OSD and the Air Force attempted to establish a firm follow-on production schedule, an effort that already extended over two years. During a meeting on 22 April 1965, in which payloads were again discussed, Dr. Fubini revived the matter with AFSC and SSD representatives. On 6 May he followed up, telling Dr. Flax that it was important that he have the Air Force's formal Titan IIIC production plan by 1 July.[27]

[redacted] Although noting disagreement with some of the production needs suggested at the 22 April meeting, he thought some user programs had become sufficiently firm to warrant detailed production planning and

[redacted]

evaluation of the impact on 1966 funding. He specifically asked for a detailed production plan that would cover IDCSP, Vela, and MOL payloads, as well as two contingency launches annually beginning in 1968.

[redacted] In June Secretary Zuckert met with the Secretary of Defense to discuss the entire Titan III program. At this time approved Titan III production consisted only of 24 IIIX's. This provided a production base for the core vehicle but not for the solid rocket motors or the transtage, both essential elements of the "C" vehicle. Following their discussions, Mr. Zuckert on 28 June submitted a follow-on production plan that incorporated the payload guidance given by Dr. Fubini. It called for the purchase of 12 Titan IIIC's with delivery at the rate of six a year beginning in 1967.[28]

Titan III R&D Payloads

(U) While many problems associated with Titan III were solved by January 1965, OSD was still concerned about the lack of payloads to assign to the R&D vehicles. On 8 January both Dr. Brown and his assistant, Dr. Fubini, queried the Air Force about this matter. Dr. Brown said that the decision to extend the R&D program provided additional opportunity to select worthwhile experiments and he requested Dr. Flax to designate an appropriate central office to manage R&D Titan III payload activity.[29]

(U) On the same day, Dr. Fubini raised the possibility of multiple payloads. He suggested that more than one payload could be assigned to each booster and asked the Air Force to undertake a study to determine whether they could be accommodated more economically by a standard dispenser or by a special multipayload dispenser.[30]

(U) Then followed a long, confusing, frustrating dialogue on the subject of payloads which was marked by failure of communication among DDR&E, OSAF, AFSC, and SSD. This situation reached a climax on

22 April when SSD, as a result of the intervention of an official on Dr. Fubini's staff, found itself presenting in-house study results to Dr. Fubini before either Dr. Flax or the Air Staff had had an opportunity to review their content or merit. However, as unsatisfactory as the presentation was, it did show Dr. Fubini and USAF officials just how wide the gulf between their thoughts had become.[31]

(U) The basic confusion stemmed from the issue of identification of funds to pay for payload integration and launch. SSD had understood that Dr. Fubini intended Titan III funding to cover all costs associated with launching R&D payloads, with the payload customer having a free ride on a free booster. Dr. Fubini, however, now insisted that the customer would pay for his ride, i.e., prorated integration and launch costs.

[redacted] Dr. Fubini nevertheless found the results of the SSD study on secondary payload vehicle concepts useful in suggesting possible ways to house multiple experiments and to inject them into orbit. However, he wished more details and tradeoff analyses of dispensers and/or "bus" concepts. On 6 May he again requested the Air Force to initiate contractor studies on techniques of orbiting multiple payloads and on the use of transtage versus injection stage subsystems. He again encouraged the Air Force to establish a small technical office to investigate the merits and feasibility of consolidating experiments in single payloads.[32]

[redacted] Dr. Flax also recognized that several misconceptions had developed and during late May and early June held discussions at several USAF echelons to get the problem back into perspective. On 22 June he confirmed the preceding guidance in a formal memorandum to General Ferguson. SSD's in-house efforts were to continue but, as requested by Dr. Fubini, the Air Force should contract for studies on the most

practical concept of integrating and dispensing multiple payloads. The Air Force was to review the merits of proposed R&D experiments and, keeping in mind overall costs, determine those with merit. Finally, it was to identify funding requirements to cover boosters, payloads, and integration for each fiscal year.[33]

[redacted] After the initial and highly successful Titan IIIC launching on 18 June, DDR&E revised its guidance on payload assignments for R&D flights. Current plans called for the launching of four Program 572Q spacecraft in June 1966 along with a third set of communication satellites. However, since it appeared that the four spacecraft would not be ready, Dr. Brown suggested that the Air Force try to meet the planned date but protect itself by outfitting Titan IIIC vehicle No. 14 as the carrier for the UHF experiment, the three-axis gravity gradient experiment, and the despun antenna experiment. To obtain maximum utility from these payloads, Dr. Brown suggested to the Air Force that it launch the vehicle into an equatorial orbit at an altitude of about 15,000 nautical miles. Dr. Brown also informed the Air Force that plans for a backup booster to Vehicle No. 10, scheduled to orbit Vela satellites, could be dropped. Finally, in view of the four successful "A" test flights, Dr. Brown directed that the Air Force convert the fifth "A" to a "C" configuration and equip it with a flexible dispenser for several meteorological, environmental, and other experiments.[34]

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* See p 44 above.

** See p 44 above.

VII. LARGE SOLID PROPELLANT MOTORS

(U) During fiscal year 1965 the Air Force continued development of the 156-inch diameter large solid propellant motor but transferred the 260-inch effort to NASA. Both these projects, which had their beginnings in 1960, were given special emphasis in 1961 by the Kennedy Administration. The main purpose was to provide backup boosters for the lunar landing mission and other space programs. Development responsibility for the solid motors was assigned to the Department of Defense (Air Force).

Reassignment of the 260-Inch Motor

(U) On 14 July 1964, after year-long OSD protestations that it no longer could or wished to support a program for which there was no military need, NASA agreed to take over management and funding of the 260-inch diameter motor development. The Air Force agreed to continue temporarily to administer Thiokol and Aerojet-General contracts and provide technical direction until NASA could take over these tasks. In September 1964 NASA assigned the work to its Lewis Research Center which organized a cadre program office in Cleveland.[1]

(U) Subsequently, the jointly managed Air Force-NASA program achieved a signal success on 27 February 1965 with the firing of a 156-inch monolithic subscale motor in the 260-inch configuration. The test, performed at Thiokol's Georgia facility, was primarily a demonstration of the nozzle and grain design to be used in the 260-inch motor. This motor, the largest rocket motor to be fired anywhere to that time, generated 3.25 million pounds of thrust in its 72-second test, twice that of previously tested liquid or solid rocket motors. Final transfer of the 260-inch program to NASA was confirmed by General Ritland, AFSC Deputy Commander for Space, on 1 March.[2]

(THIS PAGE IS UNCLASSIFIED)

Technical Progress on the 156-Inch Motor

(U) Following the successful firing of the first 156-inch motor in May 1964, the USAF contractor--Lockheed Propulsion Co.--refurbished and reloaded the original casing and again fired the motor on 30 September. During this test the unit produced about 1.2 million pounds of thrust in a burning time of about two minutes and 35 seconds--20 seconds longer than planned. The motor consumed about 650,000 pounds of propellants, 30 percent more than during the May firing.[3]

(U) On 12 December another USAF contractor, Thiokol Chemical Corp., test-fired for the first time a 156-inch motor with a moveable nozzle. The two previous 156-inch motors had been tested with the jet tab system of thrust vector control. During the December firing the motor developed a thrust of 1.3 million pounds and achieved its operating parameters precisely as predicted. The moveable nozzle demonstrated thrust deflection four times.

[redacted] After 100 seconds of operation, the plastic nozzle exhaust cone failed, resulting in an eight percent decrease in thrust level and a subsequent loss of nozzle control. This failure did not depreciate the major technical success of the test, however, and the unit was expected to require but a minor adjustment. All primary test objectives were achieved and the feasibility of large solid propellant motors in space operations confirmed.[4]

Reevaluating Development Plans

[redacted] Meanwhile, OSAF had under consideration several program changes proposed by SSD early in fiscal year 1965. The system package proposal approved in February 1964 had called for the Air Force

to develop 156-inch solid propellant motors for use as high-thrust, long-burning, strap-on boosters. However, in August 1964, on the basis of internal and contracted application studies, SSD concluded that a different approach was now appropriate.[5]

[redacted] The division now believed that since progress on large solid motor technology had exceeded expectations, the planned 1965-66 program would not take appropriate advantage of the new situation. Therefore on 18 August it proposed to Headquarters USAF a revision which would substitute both shorter duration burning and shorter length 156-inch diameter motors as well as a 90-inch diameter motor in place of the original four 156-inch motors. The cost would remain essentially the same and the smaller motors would include some technological advances.

[redacted] The projected 90-inch motor would incorporate four features never tested in a single large motor: a composite double base aluminized propellant, a fiber glass case,* a submerged nozzle, and thrust reversal ports. SSD anticipated demonstration firings of the four motors in the first half of fiscal year 1966, which would lay the foundation for accelerated development of varying length motors with diameters of 90 or 156 inches for use in a wide range of missile and space operations.[6]

* No fiber glass case as large as 90 inches had ever been fired.

[redacted]

[redacted] Although approved by the Air Staff, the proposal was treated cautiously by OSAF who felt that the effort would exceed Secretary McNamara's 1963 guidance.* Thus, when first presented to the Designated Systems Management Group (DSMG) on 25 September 1964, the package was rejected by Secretary Zuckert for additional justification. Following AFSC compliance on 13 October and review by the board structure, Under Secretary McMillan at an 11 December meeting of the DSMG accepted the recommendation that the 1965 program be approved and funds released. However, he instructed the Air Staff to examine closely the contractor bids on the proposed 90-inch motor to determine what benefits such a development would bring. Subsequently, after deciding that the contractors had proposed no significant technical advances, the Air Staff deleted the 90-inch motor.[7]

[redacted] On 26 January 1965 the Air Force awarded Lockheed contracts for two of the three motors remaining in the program. It was directed to build two 156-inch flight-configured motors with refurbishable steel cases at the 1,000,000-and 3,000,000-pound thrust levels and demonstrate both as possible first or second stage boosters. The Air Force also selected Thiokol to build and test a motor at the 325,000-pound thrust level that incorporated a flight configured fiber glass motor case and a deeply submerged nozzle that would keep the motor length under 21 feet. The contracts let in June called for motor firings in the second and third quarters of fiscal year 1966.[8]

* In November 1963 the Secretary of Defense had established dual program objectives "...of advancing knowledge and providing the technology essential to the actual development of such motors should requirements for an accelerated effort materialize at a future time." (SOD Decision/Guidance [redacted], s/Gilpatric, 19 Nov 63).

[redacted]

Efforts to Salvage Post-1965 Programs

[redacted] On 2 November 1964, while still trying to shape its 1965 program, the Air Force learned that DDR&E had tentatively reduced 1966 funding by 50 per cent (to $6 million) and deleted all funds for subsequent years. The Air Force reclama of 9 November, while accepting the 1966 reduction, sought to have an equal amount restored for 1967 and 1968. However, on 9 December OSD confirmed the earlier decision and it appeared there would be no large solid motor program authorized after 1966.[9]

[redacted] The Air Force, however, was convinced of the need to continue work on large solid rocket technology. While reviewing the 1965 program adjustments in early December, the Air Staff Board also sought to establish a position on which the Air Force could take a stand for reinstatement. In defining a program beyond 1965, however, the Air Force was faced with a fundamental question. Should basic technology continue to be explored or should the Air Force reorient toward system application? Secretary McNamara's guidance on the large solids, consistently ruling out specific system application, had established the advancement of technology as the goal. If, as AFSC seemed to imply when it submitted the revised 1965 program, the technology had been carried to the point where an almost off-the-shelf capability was assured and only a small scale effort would be needed to advance the art, then OSD's objectives would have been attained and there was no need to continue the program.[10]

[redacted] A parallel question arose. If the program was oriented toward system application, what sort of a system should it be? Space booster or ICBM? As a space booster, the 156-inch motor raised certain difficulties. That is, while it would obviously increase the thrust and

[redacted]

capability of the Titan III if substituted for that vehicle's 120-inch strap-on solids, it would also, on its own, become a direct competitor to the big booster. On the other hand, the solid rocket could have some application as a future ICBM.

[redacted] Considering these matters on 8 December, the Space Panel of the Air Staff Board decided in favor of continued investigation of technology. In the panel's view, since the Titan III would be adequate as a space booster through 1970 and there was no urgent requirement for a large ICBM capability until after 1970, the system application question was premature. It was panel consensus that continued investigation of technology for both the 120-inch and 156-inch applications was essential if the Air Force were to meet OSD's second objective of a capability for quick response to any future system requirement.[11]

[redacted]n this connection, AFSC had proposed a $12 million technology extension program plus $5.8 million for space system integration activities during 1966. Fully half of the technology program--$6 million--was tabbed for a silo-tethered or silo pop-up test, a feature related to both technology expansion and system application. The same testing was also recommended for 1967. The remaining $6 million of the technology program would be used for a submerged nozzle, hot gas thrust vector test, a used case hydroburst test, a two-stage integrated nozzle closure test, and other activities.

[redacted]The Air Staff Board endorsed and forwarded the panel's recommendations to the DSMG. At its 11 December meeting, the group accepted the board's recommendations, but Under Secretary McMillan, while giving some advice on the 1965 program, withheld comment on the 1966 proposal. However, the extensive changes required submission of a

new system package proposal and other documentation. When Secretary Zuckert reviewed these program documents on 21 May, he eliminated the provision for silo testing. The reduced program now called for $6 million annually for 1967 and 1968.

[redacted] While about half the proposed $6 million effort was related purely to technological advances, testing of large strap-on boosters also was included. Also included were continuing investigations of case fabrication and thrust vector control. The USAF package was submitted to OSD on 29 May 1965 and at year's end it awaited DDR&E action.[12]

[redacted]

[redacted]

VIII. SPACE DETECTION AND TRACKING

(U) During the year the Air Force continued its efforts to improve its Spacetrack system which was a major component of the nation's space detection and tracking system (Spadats).* Its high-powered radars and other optical and electronic sensors fed large amounts of data on objects in orbit into ADC's Spacetrack Operations Center at Colorado Springs, Colo., where a satellite catalogue was maintained. The Spacetrack system included detection fans and trackers at Shemya, Alaska, and Diyarbakir, Turkey; trackers at Moorestown, N.J., and Trinidad; and a network of Baker-Nunn cameras at Oslo, Norway; Edwards AFB, Calif; and Sand Island (Johnston Island) in the Pacific. The system was supplemented by the Ballistic Missile Early Warning System (BMEWS) radars at Thule, Greenland; Clear, Alaska; and Fylingdales Moor, England. In addition, the Air Force had under development or construction an AN/FSR-2 prototype electro-optical satellite sensor at Cloudcroft, N.M., and an AN/FPS-85 phased array radar at Eglin AFB, Fla.

Improvements and Project Delays

[redacted] In July 1964 AFSC transferred the Moorestown FPS-49 tracking radar, formerly an R&D facility, to ADC and, by the end of December, it was operating full time as a Spacetrack sensor. In October the Baker-Nunn camera facility at Edwards became operational. On 8 March 1965 ADC accepted the FPS-80 tracking radar at Shemya, Alaska. This new radar, which provided extremely accurate satellite position data at ranges up to

* The Navy's component, known as Spasur (space surveillance), consisted of a number of radars strung along the southern part of the United States.

2,500 miles, became one of the key Spacetrack facilities since it was able to detect Soviet satellites launched from Kapustin Yar within minutes of liftoff.[1]

[redacted] While these radar and optical sensors increased system capability, problems arose with the FSR-2 at Cloudcroft and the Eglin AFB radar, both of which had been scheduled to become operational during 1965. In the previous year technical deficiencies with the FSR-2 optical sensor site had required equipment modifications and delayed completion of the facility by some six months--to March 1965. Moreover, new problems as well as contract overruns developed and it seemed that a slippage of up to two years might occur before the Air Force and the North American Air Defense Command (NORAD) could put the unit into operation. The basic technical problem stemmed from the sensor's orthicon system, which did not accept sufficient light due to design deficiencies.[2]

[redacted] More discouraging was a fire on 5 January 1965, caused by high voltage shorting in the transmitter section, which destroyed approximately 75 percent of the FPS-85 phased array radar at Eglin AFB. Under construction since June 1962, the radar had been scheduled for completion on 1 April 1965. The contractor, Bendix Radio, was liable because it had not delivered the radar and it suffered a $16.9 million loss. A new delivery date was negotiated under the excusable delay clause of the contract. On 30 March OSD approved a $14.3 million reprogramming action to provide additional funds for the incorporation of previously planned improvements.[3]

System Review

[redacted] On 22 July 1964 Deputy Secretary of Defense Vance created an ad hoc group to review DOD space detection, surveillance, tracking, and

data processing activities and determine their capability, adequacy, redundancy, and efficiency--both current and programmed--for accomplishing their primary missions. This Detection and Tracking of Satellites (DATOS) Working Group, after nine months' study during which it heard presentations from many of the agencies involved, made its formal report to Secretary Vance early in March 1965. Contrary to the prevailing Air Force and ADC view, the report was generally optimistic. With respect to the catalogue, the report stated that current accuracy was more than acceptable to most users of Spadats data and that existing U.S. antisatellite programs were being adequately supported. With respect to the efficiency of existing and projected hardware, the group concluded that the performance of detection and tracking facilities was generally adequate to the tasks and demands made upon them.[4]

[redacted] The group's overall conclusion was that all existing sensors contributed in a nonredundant fashion to the operation of Spadats. Multiple detection on the first few orbits aided generally in quick determination of orbital parameters. Elimination of any sensor would leave gaps in detection coverage and would also complicate precision tracking. This would change, however, when the FPS-85 became operational at Eglin AFB in 1967. At that time, the group recommended, the Air Force should close down the Moorestown and Trinidad trackers.

[redacted] The group also recommended that the Air Force prepare and submit plans for improving the detection capability of BMEWS Site III, adding a third computer for the Colorado complex, closing the Spacetrack Center Alternate Facility at Hanscom Field, Bedford, Mass., integrating the Navy's Spasur net with FPS-85, and taking a number

of other steps to enhance tracking and detection.[5]

(U) Secretary Vance approved the group's report and on 5 May, transmitted it to the JCS and the services for guidance.* He specifically requested JCS to submit a standby plan for use of the FPS-85 as backup to the Space Defense Center as well as a plan for integrating Spasur with the FPS-85. As part of this plan, the JCS was to investigate whether or not to move Spasur headquarters at Dahlgren, Va., to Eglin. (The Joint Chiefs forwarded these instructions to the Air Force and the Navy on 22 June 1965.) Finally, Secretary Vance also directed the Air Force to submit by 1 September 1965 plans for eliminating the Moorestown and Trinidad radars from Spacetrack when FPS-85 became operational.[6]

NORAD Qualitative Requirements

[redacted] While the DATOS group was at work, NORAD officials on 17-19 November 1964 met with representatives of all unified and specified commands, military departments, and DOD intelligence agencies to discuss and consolidate their space detection and surveillance requirements. The results were incorporated into NORAD Qualitative Requirements NQR-2-65 and forwarded to the JCS in January 1965. The Joint Chiefs recognized that the requirements, if met, would create a strong capability but questioned its need. That is, the JCS felt that the requirements were more demanding than the threat justified or the negation technology would permit.[7] In commenting to OSD on 1 April, the JCS stated that it considered the requirements as goals to be reached as technology improved and asked OSD to approve them for planning purposes only. Additionally, based on current intelligence and the state of the art,

* The Air Force did not share the general OSD enthusiasm over the DATOS report, which it considered overly optimistic.

the JCS recommended certain modifications to the goals to be attained by 1970.[8]

[redacted] On 5 May Secretary Vance disapproved NQR-2-65, both because of the JCS position and for reasons of his own. Fundamentally, he disagreed with NORAD's estimate of Spadats' deficiencies and with its analysis of the threat. In this connection he asked the JCS to review the NORAD mission with respect to deep space probes. The DATOS report had noted that the only expressed requirement to detect deep space objects had come from the intelligence agencies. Since this was a unique requirement which would involve procurement of equipment not needed for any other part of the NORAD mission, Secretary Vance thought it might be appropriate to relieve NORAD of the responsibility.

[redacted] The JCS agreed that there was little military requirement for deep space ephemerides to justify special equipment but that such need might develop in the future. If this occurred, logically NORAD should exercise operational control of any special sensors. Consequently, the JCS advised the Secretary of Defense that it was inappropriate to place an arbitrary limit on altitude for NORAD's space detection and tracking mission.[9]

[redacted]

D. OTHER SPACE PROJECTS

Meteorological Satellites

[redacted] Following its establishment in 1958, NASA was made responsible for developing meteorological satellites to satisfy the requirements of all U.S. agencies. Tiros (Television Infrared Observation Satellites), the original program, was to be followed by the more sophisticated Nimbus with an operational date in 1963. The first Tiros was launched in April 1960 and by fiscal year 1964 three others had orbited. Nimbus, meanwhile, fell three years behind schedule and during 1964, at the urging of both the Weather Bureau and DOD, the space agency began work on a Tiros operational satellite system to provide an interim national capability. On 1 April 1964 OSD agreed that the general characteristics of the proposed system, now called the National Operational Meteorological Satellite System (NOMSS), would meet minimum defense requirements.[1]

The Joint Meteorological Satellite Program Office

[redacted] On 12 June 1964 DDR&E directed the services to establish a joint meteorological satellite office under general sponsorship of the Air Force to determine whether NOMSS would meet all DOD requirements or whether a separate military system was required.[2]

[redacted] Subsequently, Dr. Brown approved a proposal by Dr. McMillan to establish the Joint Meteorological Satellite Program Office (JMSPO) under the Director of Development Plans and obtain Army and Navy participation. In formally announcing formation of the JMSPO on 23 November, OSD described it as a joint staff office under the executive management of the Air Force. It was responsible to DDR&E for the staff

[redacted]

direction of the Defense Department's total meteorological satellite activities and was to serve as DOD's agent for negotiations with NASA and the Department of Commerce on such matters. Drawing on the expertise and experience of people throughout DOD, the JMSPO would, in cooperation with the Weather Bureau, continually review the NASA meteorological satellite program, define military applications of the national system, collect and consolidate service and JCS requirements, and determine if DOD needs were being satisfied.[3]

[redacted] By the end of the fiscal year, and its first seven months of operation, JMSPO was able to report some major accomplishments. The office had consolidated, evaluated, and forwarded to the Weather Bureau all of DOD's meteorological satellite requirements. In response to JCS and DDR&E requests for more security protection of meteorological satellites on which DOD would rely, it had brought together experts from many agencies and determined the hardware, techniques, and policies required to forestall enemy intrusion.[4]

[redacted] Also, JMSPO had solicited from the three services design studies for a tactical meteorological satellite. Thus, if the NASA system failed to satisfy military needs and schedules at reasonable cost, the design studies would at least give DOD a head start toward initiating its own system.

DOD Requirements for Meteorological Satellite Data

[redacted] By the spring of 1965 the JMSPO had completed a formal revision of DOD's current requirements for meteorological satellite data, which Secretary Zuckert forwarded to J. Herbert Holloman, Assistant Secretary of Commerce for Science and Technology, on 6 May along with some comments of his own. A paper containing these requirements had already been passed to NASA as the responsible government agency. In

[redacted]

discussing them with Mr. Holloman, Mr. Zuckert was continuing an exchange of information begun to assure that the Weather Bureau and the Air Force, [redacted] would have a consolidated position. As the Secretary told Mr. Holloman, he thought it important that DOD join with the bureau in additional planning for the national meteorological system. In particular, DOD had to know about the nature and timing of improvements planned for the system. In the final analysis, of course, DOD needed to know as soon as possible when the system would satisfy requirements and at what cost.[5]

[redacted] Secretary Zuckert noted that coverage of any part of the earth had to be available to DOD at all times, although actual coverage might be on a selective basis on any given day. For special DOD operations, coverage might be needed within a certain time period. He said that DOD required once-a-day and once-a-night Automatic Picture Transmission Subsystem coverage for tactical operations, a once-a-day stored readout picture for strategic application, and at least a 95 percent guarantee of a satellite in operation at all times. For special missions, DOD might occasionally ask for a special orbit. The Air Force Secretary also described a number of other specific DOD requirements for meteorological data to help it carry out its various worldwide missions.

ASSET-START

[redacted] To insure continued investigation of reentry vehicle technology following termination of Dyna-Soar, OSD in December 1963 had authorized the Air Force to expand its ASSET (aerothermodynamic/elastic structural systems environmental test) project. By the end of the fiscal year, OSD had approved an expanded research effort which included ASSET

[redacted]

as one of five closely related but separately funded elements in a new program called START (spacecraft technology and advanced reentry tests). Its objectives included many of those of the discontinued Dyna-Soar as well as others needed to establish a technological base for lifting body reentry spacecraft.

[redacted] Using analytical studies, ground experiments, and flight tests, START was to explore problems of reentry conditions, materials, and techniques to obtain basic technical data and develop design characteristics. In addition to ASSET, START included a subsonic-transonic flight test project, alternative configuration studies, advanced design studies, and the M-103 (discussed below) On 9 June 1964 OSD released deferred funds for the M-103, and SSD began to prepare work statements for the other three START elements.[6]

The ASSET Flight Tests

[redacted] The objective of ASSET was to work out structural configuration concepts applicable to the design of hypersonic aerospace vehicles, establish methods for predicting dynamic instabilities and reliability of such vehicles, and determine aerodynamic heating phenomena for lifting reentry systems. Manufactured by McDonnell Aircraft, the ASSET vehicle was 68.7 inches long and 58.9 inches wide, had a 70° swept wing 14 square feet in area, and weighed 1,100 pounds. The upper surface was shaped like a conical cylinder and the bottom was flat. The Air Force planned a series of six test flights--four with aerothermodynamic structural vehicles (ASV's) and two with aerothermodynamic environmental vehicles (AEV's). The first ASV, flown on 18 September 1963, provided a great deal of useful data and was highly successful. The second ASV launch, on 24 March 1964, failed when the second stage of the booster misfired.

(U) During fiscal year 1965 the remaining ASSET test flights were completed. The third vehicle, ASV-3, was launched on 22 July and recovered from the Atlantic Ocean. The fourth and fifth flights, the AEV's, took place on 27 October and 8 December 1964. These vehicles successfully conducted flutter and oscillatory pressure experiments and, as programmed, were not recovered.[7]

(U) The last ASSET vehicle, ASV-4, was launched on 23 February 1965. Although failing to recover the vehicle, the Air Force considered the test as a success. Excellent data was received which indicated the ASV performed as planned, reaching a velocity of 19,500 feet per second and an altitude of 205,000 feet.[8]

In its final summary of the program in April 1966, the Air Force Flight Dynamics Laboratory concluded that ASSET had amply demonstrated that maneuverable, reuseable, reentry vehicles were feasible and promising. It also noted that ASV-3, the one craft recovered in July 1965, was reflyable. It observed, too, that the program had shown that scaled-down vehicle flight testing was an excellent way to consolidate technology. The laboratory recommended that in any future high lift/drag variable geometry flight test program, major emphasis be on development of reuseable spacecraft. It suggested such spacecraft avoid water landings because of the highly corrosive nature of salt water, as evidenced in the recovered ASV-3. Finally, the laboratory noted the need for improved means of joining refractory metals.[9]

Defining the SV-5

While the ASSET launchings were proceeding, the Air Force and DDR&E were having some difficulty in agreeing on the size, configuration, and, ultimately, purpose of the M-103 test vehicle, designated the SV-5.

As distinguished from ASSET, which concentrated on acquiring data on radiative reentry vehicle structures, techniques, and materials, the SV-5 was to investigate ablative heat shield designs as well as general handling characteristics, control system requirements, and piloting aspects in subsonic and transonic speed ranges and during landing approach and touchdown. This would be accomplished through a series of four flights, beginning in December 1966. NASA would also assist with the evaluation of the low-speed characteristics of its own M-2 and HL-10 lifting body vehicles.

[redacted] The Air Force and DDR&E differences over the SV-5 fundamentally reflected the former's interest in manned space systems, requiring larger vehicles, and the disinterest of the latter, who was more concerned with the return of small data packages from orbit. Ultimately, on 2 November, Dr. Brown rejected Air Force arguments and directed it to develop the smaller vehicle with a 28-inch diameter base weighing 500 pounds, about one-half the size and one-third the weight of the vehicle favored by the Air Force. By this time, however, design of the vehicle had evolved to the point where, after long discussion in March and April, the final configuration was a 34-inch, 577-pound vehicle which would return about 80 pounds from orbit by means of an externally mounted deorbit engine. On 15 June 1965, SSD submitted a proposed development contract to Dr. Flax for approval.[10]

Nuclear Detection Satellites

[redacted] The phenomenal performance of the first pair of Program 638 satellites, launched 16 October 1963, had led ARPA to accelerate the associated research and test schedules by as much as a year. The joint ARPA-AEC-Air Force nuclear detection satellite project--the spaceborne

[redacted]

"Hotel" of the Vela project--was intended first to determine the normal radiation environment in space and then define the sensing parameters for the satellite detectors. A new launch schedule, prepared by SSD and ARPA late in fiscal year 1964, had called for launching the second pair of satellites on 15 July 1964, the third on 15 July 1965 (with backup on 15 October in event of failure), and the last on 15 July 1966.[11]

[redacted] The second pair of satellites was put into orbit from Cape Kennedy on 17 July 1964 by an Atlas-Agena booster. The primary objective was to test more sophisticated detectors and determine more precisely the characteristics of the background radiation in space. X-ray, gamma ray, and neutron detectors were to obtain data to provide additional information on test detection, satellite capabilities, and false alarm rates. A secondary objective was to place another smaller radiation detection satellite carried aloft as a piggyback load, into elliptical orbit to monitor radiation intensity continuously.[12]

[redacted] Although some difficulty in the operation of the X-ray detector of one of the Vela satellites was detected as early as 20 July, due apparently to broken windows, the problem was overcome by a redundant system and, by the end of the year, both were operating in excellent fashion. All primary test objectives were met and the program subsequently realized a bonus of extended satellite usefulness and performance which exceeded the design time of six months before failure. Moreover, the original pair of 1963 satellites continued to operate and send useful data. The piggyback satellite ceased operation on 12 January 1965, but not before it, too, had satisfied test objectives.[13]

[redacted]

[redacted] As noted elsewhere, during fiscal year 1965, [redacted] funds were supplied to two other projects, [redacted] to incorporate nuclear detector experiments in their satellites.

Deemphasizing Nuclear Power in Space

(U) Snapshot was a joint Air Force-Atomic Energy Commission (AEC) program initiated in 1961 to demonstrate the launch, orbital start up, and operation in space of nuclear reactor power equipment. AEC planned to furnish the units for flight test, while the Air Force developed command and control, power distribution, and test equipment to operate the reactors, provided the Agena satellite and Atlas booster, and conducted the flight test. During fiscal year 1964 Snapshot almost came to a premature end: Snap 2 was cancelled and only Congressional intervention saved Snap 10A from a similar fate. However, as a result of continuing DOD shortages, AEC agreed to fund the work in fiscal year 1965.[14]

Snap 10A

(U) On 3 April 1965, after almost four years' preparation, Snap 10A was successfully launched from Vandenberg AFB into a near-perfect circular orbit by an Atlas-Agena booster. Four hours after injection into space, the nuclear reactor was remotely activated by removal of its internal shielding that had kept the emission of electrons from the Uranium 235 fuel element from reaching the chain reaction stage. The reactor immediately began to provide power for a small ion engine in this first attempt to test a reactor-ion system in orbit.[15]

(U) Twelve hours after launch, radio signals from the satellite indicated that the reactor was producing 620-668 watts of electricity--about

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[redacted]

20 percent more than its designed power. This electricity was stored in a bank of batteries which released it as the ion engine was put through a series of starts and stops. After successfully operating for more than six weeks, Snap 10A unaccountably shut down on 16 May. The first indication of trouble came when the satellite's reactor-powered telemetry ceased. Forty hours later, telemetry was started up by standby batteries, indicating the reactor had shut itself down and was no longer producing power.[16]

(U) AEC had planned to conduct a second flight test, but shortly after the end of the fiscal year the commission informed the Air Force that it was cancelling the arrangements because no practical use had been established for the power device.[17]

Snap-50/Spur

(S-Gp 4) Snap-50/Spur was a cooperative USAF-AEC-NASA effort to develop technology for lightweight nuclear space power equipment rated at 300 to 1,000 kw and designed for 10,000 hours of continuous operation. During fiscal year 1964 both AEC and DOD cut back on this work, OSD limiting the Air Force to $1 million for investigations of the spacecraft's design constraints on the power unit.[18]

(U) The 1965 effort continued at a low level and at midyear it became obvious that AEC's 1966 budget for Snap-50/Spur would be very low. Since the Air Force was unable to describe a military use for such a large power source, it could not assist the agency in its battle for funds. The commission's funds were cut as expected, and it reduced its space effort drastically. Thus, at year's end, USAF-AEC joint efforts on space nuclear reactors were almost negligible.[19]

[redacted]

NOTES

Chapter I

1. Testimony of SECDEF Robert S. McNamara in House Hearings before Subcmte on Appn, 89th Cong, 1st Sess, DOD Appropriations for 1966, p 270; 88th Cong, 2d Sess, DOD Appropriations for 1965, p 235.

2. NASA Chronology (U), Aeronautics and Astronautics, 1965, pp 42-3; 153; 171; 290-1 /hereafter cited A&A/ ; testimony of SAF Eugene M. Zuckert before Subcmte on Appn, 89th Cong, 1st Sess, DOD Appropriations for 1966, 855-6.

3. "Cost Key to Military Man in Space," in Missiles and Rockets, 8 Mar 65.

4. Hist (U), Dir/Dev, Jul-Dec 64, p 14; Hist (U), Dir/Dev, Jan-Jun 65, p 14.

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GLOSSARY OF TERMS AND ABBREVIATIONS

A & A	Astronautics and Aeronautics, NASA annual reports
AACB	Joint NASA/DOD Aeronautics and Astronautics Coordinating Board
ack	acknowledge(d)
ADC	Air Defense Command
ADCSP	Advanced Defense Communication Satellite Program
AEC	Atomic Energy Commission
AEIP	Augmented Engine Improvement Program
AEV	Aerothermodynamic Environmental Vehicle
AFETR	Air Force Eastern Test Range
AFSC	Air Force Systems Command
AFWTR	Air Force Western Test Range
AGE	Aerospace Ground Equipment
alt	altitude
altn	alternative(s)
appn	appropriation(s)
ARPA	Advanced Research Projects Agency (DOD)
ASB	Air Staff Board
asgn	assignment
ASSET	Aerothermodynamic/elastic Structural System Environmental Test
ASSS	Air Staff Summary Sheet
ASV	Aerothermodynamic Structural Vehicle
bm	ballistic missile
BMEWS	Ballistic Missile Early Warning System
bud	budget
comd	command
Comd Con and Comm	Command Control, and Communications (Directorate of)
comm	communications
ComSatCorp	Communication Satellite Corporation
con	control
CONAD	Continental Air Defense Command
cmte	committee
COMSAT	Communication Satellite
cpbl	capability(ies)
DATOS	Detection and Tracking of Satellites (Working Group)
DATS	Despun Antenna Test Satellite
DCA	Defense Communications Agency
DD	Development Directive
DDR&E	Director of Defense Research and Engineering
dev	development
diam	diameter
Dir	Director, Directorate
dmstn	demonstration
DOD	Department of Defense
DSMG	Air Force Designated Systems Management Group
DTS	Detection Test Series (461 flights)

Elct	Electronic (as part of an agency designation)
ETR	Eastern Test Range
eval	evaluation
fclty	facility(ies)
flt	flight
GAO	General Accounting Office
GEMSIP	Gemini Launch Vehicle Stabilization Improvement Program
GGS	Gravity Gradient Stabilization
GLV	Gemini Launch Vehicle
gp	group
I&L	Installations & Logistics
ICBM	Intercontinental Ballistic Missile
IDCSP	Initial Defense Communication Satellite Program
ILC	Initial Launch Complex (of Titan III)
intcp	interceptor
ITL	Integrate-Transfer-Launcher (of Titan III)
JCS	Joint Chiefs of Staff
JMSPO	Joint Meteorological Satellite Program Office
KSC	Kennedy Space Center
LODUS	Low Data Rate UHF Satellite
LSPM	Large Solid Propellant Motor
MCP	Military Construction Program
mgt	management
MILA	Merritt Island Launch Area
MOL	Manned Orbiting Laboratory
MR	Memorandum for the Record
msl	missile
MRBM	Medium Range Ballistic Missile
MTBF	Mean Time Before Failure (satellite)
NASA	National Aeronautics and Space Administration
NM	Nautical Miles
NOMSS	National Operational Meteorological Satellite System
NORAD	North American Air Defense Command
NRD	National Range Division (cf AFSC)
Ofc	Office
off	officer(s)
orgn	organization
OSAF	Office of the Secretary of the Air Force
OSD	Office of the Secretary of Defense
PCP	Program Change Proposal
PD	Program Directive
pdn	production
PEM	Program Element Monitor
plcy	policy
proj	project

RDT&E	Research, Development, Testing, & Engineering
rqmt	requirement(s)
RTS	Research Test Series (461 flights)
SAC	Strategic Air Command
SAF	Secretary of the Air Force
SCF	Satellite Control Facility
sched	schedule
SECDEF	Secretary of Defense
SLBM	Submarine Launched Ballistic Missile
SLV	Standard Launch Vehicle
Spadats	Space Detection and Tracking System
Spasur	Space Surveillance (Navy System)
SPD	System Program Directive
SPP	System Package Program
spt	support
SSD	Space Systems Division (of AFSC)
START	Spacecraft Technology and Advanced Reentry Tests
sys	system(s)
TDP	Technical Development Plan
Tiros	Television Infrared Observation Satellites
TMS	Tactical Meteorological Satellite
UHF	Ultra High Frequency
U/SAF	Under Secretary of the Air Force
util	utilization
VAFB	Vandenberg Air Force Base
veh	vehicle(s)
WTR	Western Test Range